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CHEMICAL
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# ENGINEERING

VOLUME 42 ESTABLISHED 1902 NUMBER 2

McGRAW-HILL PUBLISHING COMPANY, INC.

S. D. KIRKPATRICK, Editor

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EDUCATION ON TRIAL?

LAST SPRING when the largest of the world's distilleries was about to go into production, its executives faced an interesting problem. From what source should they recruit the operating personnel? Obviously a few key men of experience were essential but most of the openings were in positions for which technical training had never been considered a necessary qualification. Nevertheless, among the many applicants for jobs were a number of young chemists and chemical engineers who were quite willing and anxious to accept the going wage of $35 per week. The best of the lot were hired despite the fact that several well-meaning observers raised the question of the ultimate fairness to the men, to the employer, and to society as a whole. Do *you* think the company's managing executive—himself a chemical engineer—made a mistake in thus investing in higher education?

Within the next few weeks another large plant in the Middlewest—variously estimated to have cost between six and ten millions of dollars—is going to begin operations. Several hundred men are required for its staff and under normal circumstances considerably less than half of these would be technically trained. Yet when the word went around that preference would be given to college men who had already been employed on the construction force, again there turned up a surprising number of good chemists and engineers. Again the decision was made in favor of the technically trained operator. Again the question was raised: Is it fair to put ambitious young technical men into jobs which ordinarily would be filled by semi-skilled workmen? Would *you* if you had the hiring, prefer to concentrate your technology at a higher level in the organization rather than scattering it throughout?

Before you answer these questions, consider the fact that these plants represent the last word in modern chemical engineering construction. Every type of precision regulator and automatic controller applicable to these processes have been installed. Although operating procedures may have been simplified to the point of elementary routine, the equipment itself is costlier and more complicated than in the average industry. Serious hazards to life and property might be involved in any major failure—human or mechanical. Hence from a purely selfish viewpoint, management in these plants would seem to have had good reason for picking brains instead of brawn.

But if you are shrewdly minded, you ask: "Isn't the company taking the chance of an abnormally high turnover a few years hence when someone else starts bidding for technical men? Isn't it paying out good money merely to train men for some competitor?" Or, if you are an educator like some we have talked to recently, you ask: "Isn't this an admission of defeat if college trained chemists and chemical engineers have to enter industry on the same plane as the untrained workman?"

Frankly, we refuse to be disturbed about the situation for we think it may prove a good thing for all concerned. Too many of our educators have been training men to think that only research offered worthwhile careers—that plant operation (except as boss) was beneath the dignity of a graduate chemist or chemical engineer. If the depression has taught us anything, it is that the value of a college education is just what the man himself makes out of it. Education is on trial only because some educators refuse to look on life as it is.

From an EDITORIAL Viewpoint

A Good Chance to Write Your Congressman

AFTER several false starts in durable goods recovery, the air is again full of plans looking toward improvement in this most vital spot. With sufficient urging along the right lines Congress can doubtless be persuaded to do something in the present session, particularly if, as anticipated, the Administration advances legislation which it is understood to be considering.

The least common denominator of several plans that have currently been offered, as has been true in a number of successful European schemes, is tax relief for industry in proportion to its expenditures for capital goods. Thus, if a corporation invest $1 million out of net current earnings in new equipment, it will save up to $137,500 in Federal taxes. Some of the taxes will, of course, be paid by the supplier of the equipment, but he will have enjoyed good business and will be more than willing to pay them.

One of the plans, in addition to this feature, involves an agreement on the part of the government to approach a balanced budget in proportion to industry's absorption of the unemployed, while at the same time the government will confer with industry with a view to the development of a plan for the lending of money to industry for plant rehabilitation. Whatever the details, however, the general idea is much to be desired. If industrialists will make themselves heard in Washington on behalf of the capital goods industry, the good work will be speeded on its way.

T.V.A. Fertilizer Plans Should Be Conservative

CONSTITUTIONALITY of T.V.A. as a government agency in private business is being seriously challenged in the federal courts. A preliminary finding limiting the scope of the first trial shows that the federal judge in this case takes most seriously the charge that T.V.A. activities with respect to power may be beyond those rightfully attaching to a federal enterprise. Should such finding be reached formally and approved in the higher courts, an even more drastic restriction on fertilizer activity would probably follow.

Under these circumstances, a conservative planning of the fertilizer investigations would seem essential. There is easy means for reaching such conservatism without sacrifice either of pride or progress on the part of T.V.A. itself. Only two simple decisions are needed. First T.V.A. can make up its mind that it will not sell fertilizer in competition with commercial manufacturers for the present. Second it can decide that the rate of operation of its producing plants shall be within limits appropriate to the first decision. This does not mean that the present electric furnaces or the proposed blast furnace for phosphoric acid need be abandoned. It means only that they should be regarded in fact, not merely in name, as "experimental."

Three splendid outlets for fertilizer are open within these restrictions. It can be used for agronomic research in connection with state or agricultural agencies. It can be used on demonstration farms to stimulate the wider use of fertilizer in this territory. It can be utilized in soil-erosion prevention and fertility-restoration programs now actively under consideration by other divisions of the Government. The combination of these three applications will be quite enough to demand active use of the present and projected facilities at Muscle Shoals.

No one can claim that conservative utilization programs will interfere with proper technological research. It is to be hoped, therefore, that conservatism in planning will be achieved.

A Problem for The Profession

HARRY McCORMACK, as all who know the redoubtable professor at Armour Institute will surely agree, is not in the habit of "pulling his punches." He fights hard and fair for what he believes to be the good of the profession. He may be criticized for his bluntness but never for pussyfooting. What he has to say about a striking need in chemical engineering education (in a characteristic article published elsewhere in this issue) is something that the profession may well ponder. A real problem is before us: How to bring laboratory instruction in the unit operations up to the present high standards of most of the theoretical instruction in chemical engineering.

Not mentioned by Professor McCormack but of significance in connection with his discussion, is the fact that the first laboratory instruction in chemical engineering directed toward the unit operations was that offered at the Armour Institute of Technology in 1908 (see A. H. White, A.I.Ch.E. Silver Anniversary Volume, p. 355, 1933). Thus for more than a quarter of a century this author has had an opportunity to test out in actual practice his ideas as how best to instruct the undergraduate in the practical application of the unit operations. His article not only summarizes that long experience, but raises a number of interesting questions. Actual standardization of courses would be undesirable, he holds, but would it not be possible to agree on some uniformity in purpose and objective? What is the minimum equipment and

other facilities absolutely necessary for adequate instruction in chemical engineering? What proportion of time should be devoted to engineering, operating and process experiments? How much information is to be given the student and what is to be required of him? Most important of all, what suggestions does the employer of future chemical engineers have to offer that will make this type of instruction more effective in bridging the gap between the course in college and the job in industry?

Fortunately, there will probably be an opportunity to discuss and perhaps answer many of these questions in a symposium to be held in May in connection with the Wilmington meeting of the American Institute of Chemical Engineers. Definite plans have not yet been announced but it is known that the committee on chemical engineering education, under the chairmanship of Dr. Harry A. Curtis, has a program under consideration which will definitely focus attention of both teacher and industrialist on this important need of the profession.

Professor McCormack's article will, we hope, stir your interest in the possibilities for further advance in this phase of chemical engineering education. He would be most happy if it would lead to constructive criticism and helpful suggestions not only from educators but from the practitioners of chemical engineering in industry.

Isn't it Worth Your Support?

ENGINEERING INDEX, which for fifty years has cataloged the technical literature in every branch of engineering, has reached a point in the road where its continuance depends on industrial support. The service provided by the Index is unique in its field and is duplicated by no other indexing and abstracting service. Without it engineering would be the only major field of scientific knowledge without such organization of its current literature.

In 1934 the Index, which had previously been the responsibility of the American Society of Mechanical Engineers, was made independent and was organized as a non-profit corporation, under the presidency of Dean Collins P. Bliss of New York University's engineering school. Dean Bliss is not approaching industry hat in hand, but with the full and certain knowledge that the $160,000 working capital fund which will be required to put the organization on a self-sustaining basis is one of the best investments in the future of the engineering industries that can be made. Several companies in process industries have made generous contributions to this fund. Others are expected.

How Blow The Trade Winds?

BRAZIL'S trade agreement announced early in February shows at least in part the extent to which the State Department ideas are maturing on industrial commodities. It is wrong to conclude, however, that future agreements with European nations will have so little interest for domestic chemical industry as does this first bilateral arrangement. Other European agreements must touch on vital industrial products of far more concern to chemical engineering industries than is manganese ore.

In one respect the Brazilian treaty is very illuminating. It provides that the duty on manganese ore be lowered in order to afford larger market in the United States for that commodity from Brazil. But the State Department indicates that other nations are to have like benefit, except of course Russia, with which we do not have a most-favored-nation arrangement. Incidentally Cuba is likely to be more seriously hurt by the development, as production costs there are much higher than in the other three countries which are important producers and which get the tariff benefit, namely Brazil, British India, and the African Gold Coast.

More Trouble For Coal Industry?

NATURAL gas wasted to the air in the Texas Panhandle today represents a heating value equal to at least two-thirds of the total marketed production of gas for the country as a whole. This is far greater than the utilized heat from all kinds of manufactured gas plants of the nation. Suddenly Secretary Ickes has discovered the social-economic meaning of this waste. He proposes to do something about it.

Two possible steps in correction could be taken. Some effort could be made to strengthen the Texas conservation regulations to prevent outright waste at the source. Effort in this direction is expected. More effective would be the plan now seriously being considered by PWA Administrator Ickes to build new pipelines to convey great additional quantities of this gas from the point of waste to centers of utilization. St. Louis and Detroit are specifically mentioned as potential destinations. The principal economic obstacle is the fact that such pipelines, if properly planned and successfully managed, would take fuel into these territories which would supplant coal. The single long pipeline from Texas to Chicago does just this, potentially carrying into the Windy City each 24 hours the equivalent of 10,000 tons of bituminous coal. It would take 10 more such pipelines, with a corresponding coal replacing potentiality, to absorb the Texas waste of natural gas.

These new lines cannot come into being overnight. The coal industry will not let this proceed unchallenged. But the trends are such that chemical industry, always interested in cheap fuel, will watch closely in order that it may fully take advantage of the developments as they occur and may not be overtaken by unexpected competitive developments of serious magnitude.

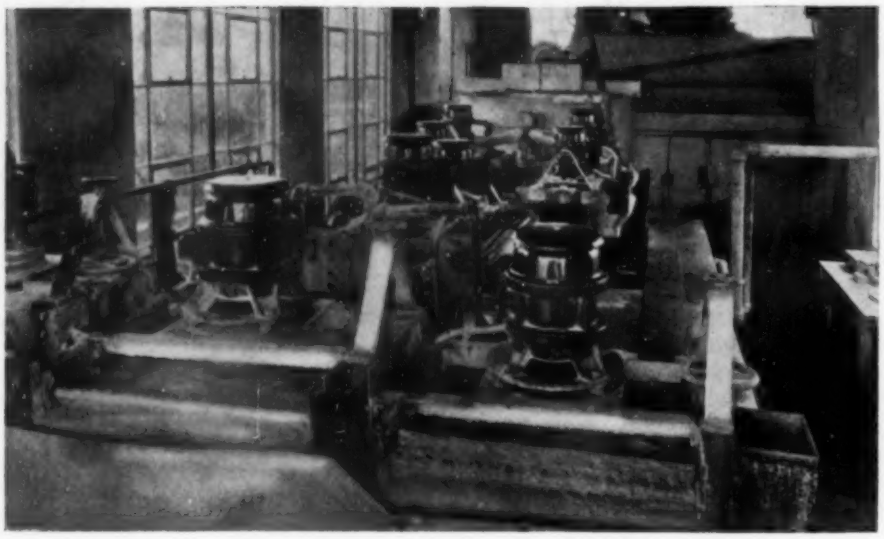


Fig. 1—Flotation cell room of Valley Forge Cement Co.'s mineral separation plant; from rear to foreground equipment is as follows: rake classifier, Turbomixer, rougher cells, recleaner cells, cleaner cells

FLOTATION Solves a Problem in Process RAW MATERIALS

By THEODORE R. OLIVE
Associate Editor, Chem. & Met.

LESS THAN a year ago every portland cement mill in the world was, to a greater or lesser extent, at the mercy of its raw material reserves. Today, through the pioneering of one mill, the industry has available a mineral separation process which promises a control over raw materials never before possible. Eleven months of successful commercial operation of the new froth flotation plant installed at West Conshohocken, Pa., by the Valley Forge Cement Co., has proven beyond a doubt that low grade raw materials can make high grade cement; that, simultaneously, both mill and quarry costs can be reduced by more than enough to pay for the added processing; and that in most cases a single raw material source—almost regardless of what the source may be—suffices for every type of cement. Additionally, concurrent experiments have shown that argillaceous limestone can provide $CaCO_3$ of a quality even better than that required for chemical lime production.

The application of the froth flotation process to the beneficiation of non-metallic minerals is not a new idea, although until recently it was limited to phosphate rock concentration. Within recent years the process has been extended to coal, to fluorspar and feldspar and is now being mentioned as a possibility for other ceramic raw materials. It remained, however, for C. H. Breerwood, vice president and general manager of the Valley Forge company to reason that, if a cement raw material lacked sufficient of a necessary component, then conversely, it contained too much of other constituents which might conceivably yield to removal by a flotation method. The conclusion of this reasoning came only after a number of years painstaking research in petrography, in separation methods and in cement chemistry, but brought with it dividends of success and of hitherto unsuspected advantages which may be counted among the most important developments the industry has yet experienced.

The problem at Valley Forge was not one of a particularly low grade of raw material. Nor was it necessary to ship in high-lime stone, as many mills must do, to correct a deficiency existing in the company's own quarry. Rather, the difficulty lay in the quarrying cost incident to the selection of the most suitable stone and in the usual cement mill troubles arising from a lack of day-to-day uniformity in the available mix. Cement mill chemists have always been tied to their raw material supplies. So it was at Valley Forge. Variations in rock composition within the quarry, plus the blending tanks, sufficed for "standard" cement. But this was not what Mr. Breerwood wanted. What he wanted was independence of the quarry's vagaries, independence of the blending tanks and a means for taking his raw material apart and putting it together again in ideal proportions.

Actually, the process as practiced is not one of "taking apart and putting together." It is not a true synthesis, but accomplishes the same thing by the *subtraction* of unwanted constituents and, thereby, retains the natural blend or mixture. In order to understand how this can be done with an apparently homogeneous mass such as a cement rock, it is necessary first to look into the true nature of the rock. This Mr. Breerwood did with the aid of a petrographic microscope, a trained petrographer, thin rock sections, polarized light, gypsum slides and,

where necessary, index solutions. Here is what he found—a thing that was not previously recognized: that not only the Valley Forge rock, but every one of the numerous limestones, marls, and clays examined was an agglomerate of discrete minerals, bonded mechanically; that eight easily recognized minerals comprised the bulk of these samples; and that the mechanical bonds could be broken sufficiently by various degrees of grinding. It remained only to discover an economical method of separating the constituents, once the bond was ruptured—a method which was found in froth flotation.

The sketches of Fig. 2, made from photomicrographs, will serve to illustrate the processes of rupture and separation. No two rock samples are identical, of course, but the several views are at least typical. Silica occurs in cement minerals in both crystalline and amorphous forms; alumina in the form of silicates, chiefly micaceous; iron as limonite and pyrite; and carbonate minerals chiefly as calcite (with or without some $MgCO_3$). Amorphous carbon is often found, as is apatite.

Sketch 2 *a* is taken from a thin section of the Valley Forge rock and shows a field of calcite containing large particles of silica (quartz) and alumina bodies and a little iron. After grinding, such a sample would have some such appearance as that shown in *b* which is taken from the oversize particles of a separation process later to be described. Sketch *c*, made from the concentrate produced by flotation, shows a preponderance of calcite and two particles each of silica and alumina. A small iron inclusion in one of the calcite particles is to be noted. This sample has not been completely cleaned of silica and alumina for the reason that it would be neither economical nor desirable to do so, since some of both materials are needed in the final mixture. The last sketch, *d*, typifies the rejects of the flotation process, showing much quartz and alumina and a little calcite. Most of the calcite, it is evident, is attached to reject particles. Had the grinding been finer, it would probably have gone into the concentrate.

These drawings illustrate another interesting point that was one of the motives of the investigation—namely, that not all the silica is equally available to the cement reactions. One of the major mysteries of cement manufacture has been the unaccountable way in which mixes analyzing the same would burn differently, yielding variable results. Silica in silicate form is readily fluxed, but not so a large quartz particle surrounded by a number of small calcite particles. Although in the latter case the equivalent reacting quantities might be present, the reaction could not be complete. It became apparent that, because of their hardness, large silica particles would normally be present in the clinker—but that a much better place for them would be in the rejects. As reasoned, so it worked out—with better uniformity of results, lower fuel expense and decrease in the costs of raw grinding.

Enough has now been stated to show the background for the processes used in this beneficiation. Rock from the company's quarry is dumped on to a feeder, washed with streams of water and passed through a Traylor preliminary jaw crusher and hammer mill where it is reduced to size for the tube mill feed. As Valley Forge is a wet process plant, the rock is ground wet in two Polysius compartment tube mills to 85 per cent through 200 mesh. This compares with the former requirement of 87 per cent through 200 mesh in the days before the rejection of the coarser silica particles (and with the resulting present *final* mixture of 91 to 92 per cent through 200 mesh). The slurry is then pumped to a feed tank on the hill above the hillside-type concentration plant.

Fig. 5 is a general view of the concentration plant showing the location of all principal pieces of equipment. From the feed tank the slurry passes through a 30-ft. Dorr hydroseparator, after its dilution with water, and here it is separated into plus and minus 325-mesh fractions. The hydroseparator, which is nothing more nor less than an overloaded thickener, thus acts as a 325-mesh sieve. The overflow of minus 325-mesh material goes to an 80-ft. Dorr thickener, where it is mixed with the concentrates, and thence to the kilns, but the underflow goes to the cell house for separation into concentrates and rejects.

This underflow, however, is not all plus 325-mesh, for

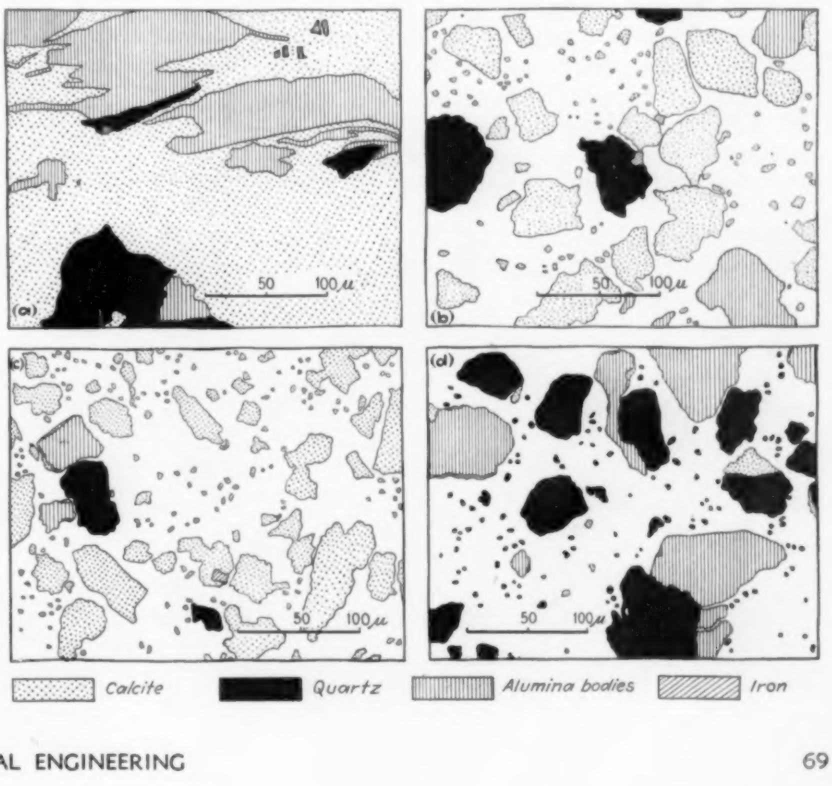


Fig. 2—Cement rock at four stages in the Valley Forge process (drawn from photomicrographs)

(a) Unground Valley Forge cement rock analyzing approximately: silica, 15.56; iron oxide, 1.69; alumina, 6.13; and lime, 39.53 per cent

(b) Head sample from the classifier, before processing, analyzing approximately: silica, 15.56; iron oxide, 1.69; alumina, 6.13; and lime, 39.53 per cent

(c) Flotation concentrate, analyzing approximately: silica, 3.82; iron oxide, 1.22; alumina, 2.52; and lime, 47.98 per cent

(d) Flotation reject, analyzing approximately: silica, 57.76; iron oxide, 1.04; alumina, 20.42; and lime, 6.23 per cent

Note how little the hydroseparator and classifier affect the composition in comparison with the next step, flotation. Note also how the calcite percentage increases while that of silica and alumina declines in the concentrate, with reverse effect in the rejects.

Flotation, of course, is the objective of the preparation so far described. In the mixer the sands are kept in suspension, flowing out through a box in which a small

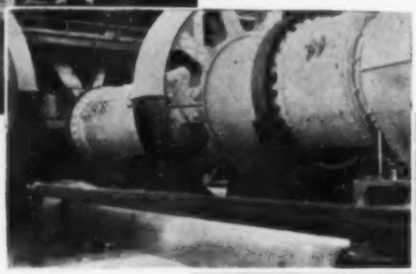


Fig. 3, Above—Start of the process, the crusher house, with the rock and clinker storage in the background

Fig. 4, Right, above—One of the Polysius compartment tube mills used for raw grinding

Fig. 5—General view of the separation plant with the kiln building at the left

the hydroseparator cannot prevent the entrapment of some of the finer particles. On this account, then, the underflow is passed through a Dorr rake classifier, the fines from which are returned to the hydroseparator. The rake product, or "sands," is carried by screw conveyor to a Turbo-mixer, there to be diluted with water and put into suspension for the flotation process. It is at this point that the control of the process is introduced. As is shown in the flow chart of Fig. 6 a swing pipe installed in the deep end of the classifier is provided to withdraw and add to the sands a part of the material which otherwise would return to the hydroseparator. By varying the quantity so withdrawn and by varying the underflow from the hydroseparator, the relative percentages of mill stream treated and untreated are controlled. As Table I shows, these relations depend upon the percentage of calcite in the mill stream. Obviously, to attain a fixed percentage of calcite in the final product without resorting to blending, a percentage varying inversely as the raw rock calcite content must be concentrated.

At this point it will be well to examine Table II which shows the composition variations for a particular grade of rock that occur in various parts of the system. The table shows also how moisture content and screen size change throughout the process.

Table I—Relation Between Calcite Content of Rock and Percentage Treated by Flotation

Per Cent $CaCO_3$ in Rock	Per Cent to Cell Feed	Per Cent $CaCO_3$ in Rock	Per Cent to Cell Feed
68	53.5	72	39.8
69	51.0	73	34.3
70	47.3	74	29.0
71	43.4	75	22.7

quantity of oleic acid is added. This is known as a collecting agent and is believed to react selectively with the calcite particles, producing a thin layer of calcium oleate on their surfaces. The stream then passes in parallel through two pairs of flotation cells connected in series. In these, the "rougher" cells, a small quantity of frothing agent—generally cresylic acid—is added and the mixture thoroughly whipped up with air. A froth of fine bubbles rises to the top, carrying with it the oleate-coated calcite particles. Uncoated particles, however, are unaffected and sink to the bottom where they are withdrawn. The froth from the rougher cells is scraped off into launders, discharging to a 27-ft. concentrate thickener. The underflow from the first of each pair of rougher cells flows to the second where it is re-frothed, then discharged to the cleaner cells for the re-

Fig. 6—Flow diagram of the separation plant at Valley Forge Cement Co.

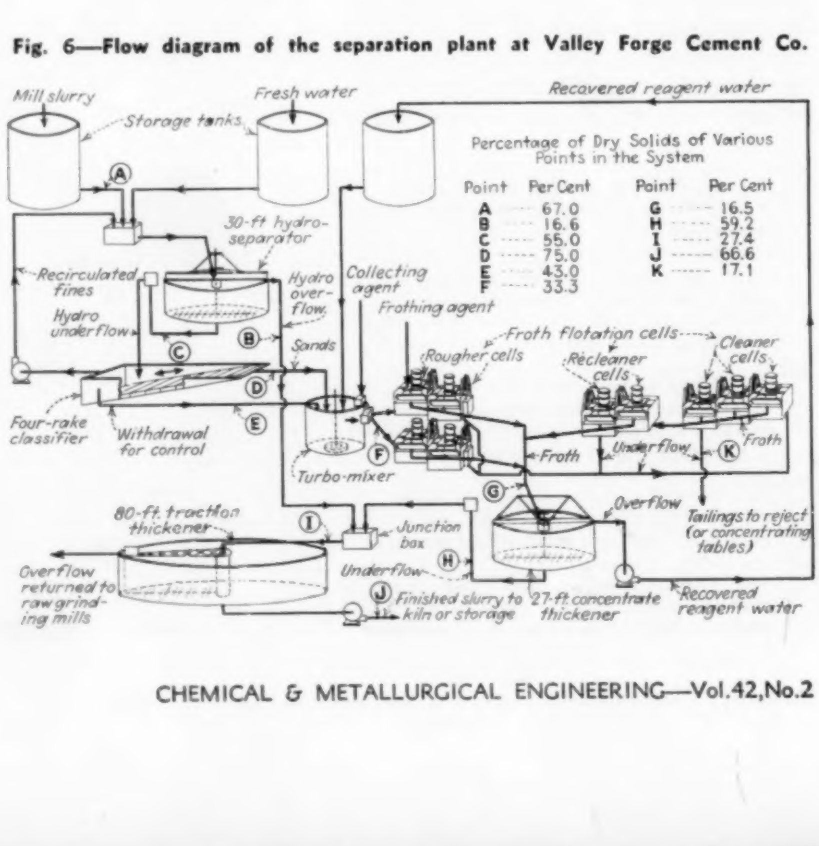


Table II—Compositions and Quantities of Materials Passing Various Points in the Process Per 24-Hour Day

(Basis: 700 tons of 72.2 per cent $CaCO_3$ rock per 24-hr. day, of which 39.7 per cent is treated)

	Mill Stream		Hydro Overflow		Cell Feed		Concentrates		Rejects		Final Mix	
	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent
Total	700.00		460.00		240.00		195.00		45.00		655.00	
$CaCO_3$	505.40	72.20	327.00	71.10	178.80	74.50	169.60	87.00	9.00	20.00	496.70	75.80
SiO_2	96.90	13.84	64.80	14.09	32.10	13.38	8.80	4.50	23.30	51.80	73.60	11.25
Fe_2O_3	11.60	1.66	7.03	1.53	4.57	1.90	3.33	1.71	1.24	2.74	10.36	1.58
Al_2O_3	37.38	5.34	25.90	5.63	11.48	4.77	3.43	1.76	8.05	17.89	29.30	4.48
$MgCO_3$	46.40	6.62	31.10	6.76	15.30	6.38	13.40	6.87	1.90	4.22	44.50	6.80
Per cent through 325 mesh		72.50		96.10		27.30		31.20		7.00		77.00
Per cent dry solids		67.00		16.60		33.30		16.50		17.10		66.60

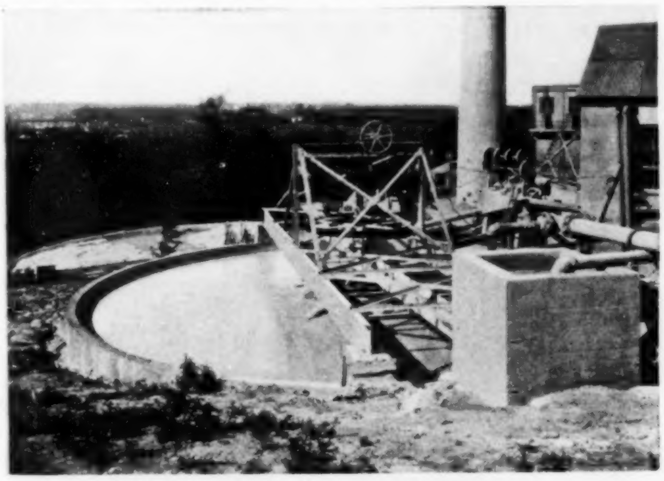
Note: Cement produced from this mix analyses approximately as follows: SiO_2, 19.60; Fe_2O_3, 2.60; Al_2O_3, 6.60; CaO, 63.15; MgO, 4.60; SO_3, 1.90; and loss, 0.62 per cent.

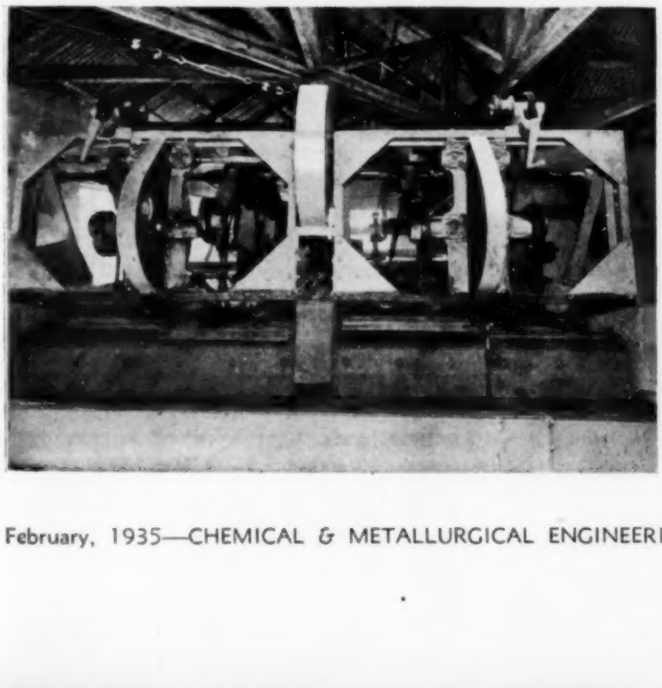
covery of any calcite not floated in the primary stage.

The three cleaner cells, placed in series, float a froth which is higher in silica and alumina than the first concentrate and this is re-treated in a third group of two recleaner cells. The froth from the recleaners joins that from the roughers, passing to the concentrate thickener, while the underflow joins that from the roughers, going to the cleaner cells. The underflow from the cleaners constitutes the "tailings," or rejects, and consists chiefly of alumina and silica with a small quantity of calcite. Although the cells are operated to produce a reject of 20 per cent calcite, it will be observed that this is less than 2 per cent of the calcite in the original mill stream.

Fig. 7—Dorr hydroseparator which serves as a 325-mesh sieve for the raw slurry

Fig. 8—Dorr rake classifier from the head or "sands" end





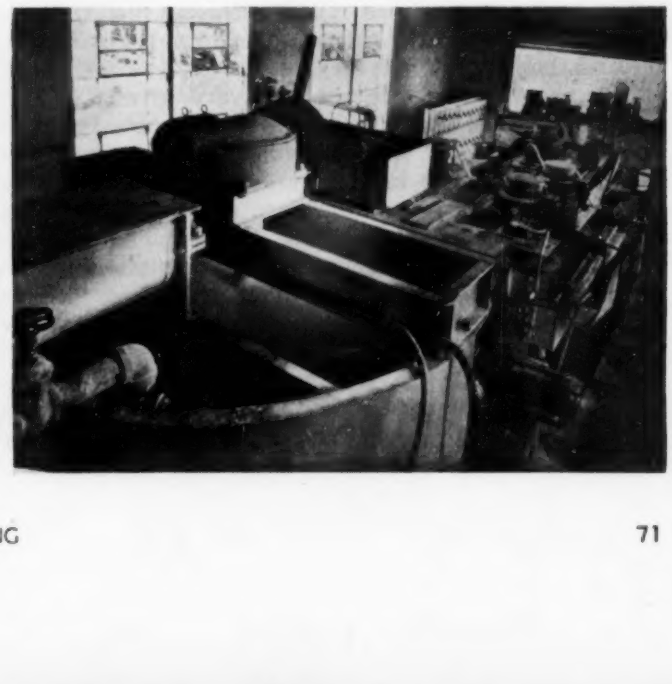
This loss is far below that which previously had to be borne in the process of selection at the quarry, employed before the introduction of the flotation system, and does not warrant finer grinding for further calcite recovery.

Most separation means are based on particle size or specific gravity differences. Froth flotation, however, depends only on selective coating, and bubble attachment, as will be evident from the fact that the densities of calcite and silica are almost identical. The cells used (Figs. 1 and 10) are the Fagergren type of American Cyanamid Co. Each of the cells consists of a box-like container within which is a vertical, cylindrical stator cage of tubular members. Inside the stator is a motor-driven rotor of similar construction, except that its top and bottom surfaces are formed as impellers. The effect of rotation of the inner cage is to draw pulp into its center through a bottom inlet port, at the same time drawing in air through controlled ports above the pulp level in the container. The air is dispersed in the pulp and the dispersion violently expelled through the stator elements into the tank. Part of the tank content is recirculated and part withdrawn at the bottom to the next machine. The froth is removed by a pair of rotating blades.

As fast as it overflows from the rougher and recleaner cells the concentrate gravitates to a 27-ft. Dorr thickener, where about 40 per cent of the reagent water is recovered for reuse. The underflow is mixed with the overflow from the hydroseparator and is then thickened to a suitable kiln feed in an 80-ft. Dorr traction thickener.

What is the efficacy of this system and what are its implications? In answer to the first question, since the new separations plant was started in March, 1934, the

Fig. 9—Turbo-mixer which feeds slurry to the flotation cells in the background



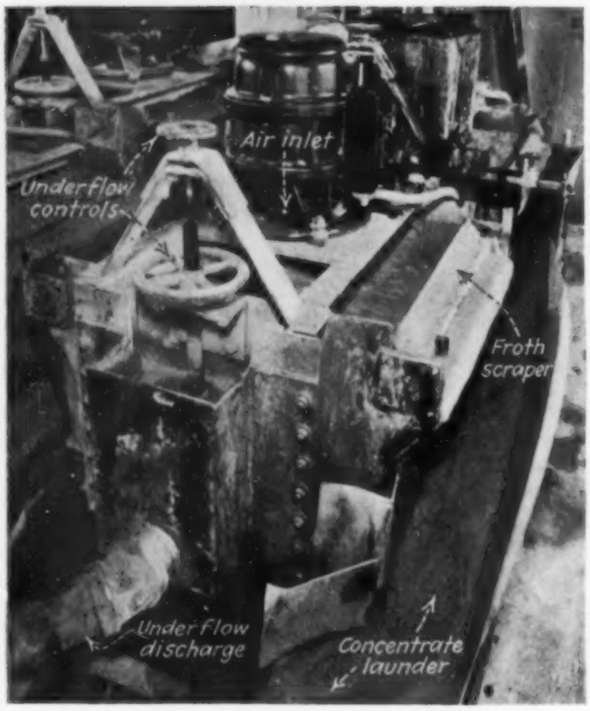


Fig. 10—One of the Fagergren flotation cells showing froth and underflow discharge

cement has been produced solely from inferior and unsuitable stones, all below "composition" in $CaCO_3$. Stone discarded in the seven years since the mill was built has been utilized. This has straightened the quarry for easier operation and when high-grade stone is reached, it, too, will be treated to remove the coarse quartz and mica and to correct the ratios, which cannot be accomplished by customary blending methods. Since the process was instituted, the better condition of the kiln feed has made possible a reduction of about 10 per cent in coal, nevertheless producing a harder, denser and absolutely uniform clinker which grinds to cement of higher early and ultimate strength. Ability to employ run-of-quarry rather than picked material has cut quarrying costs sharply, while at the same time it has added an estimated 150,000,000 bbl. of mix to the company's reserves. As mentioned in an earlier section, the elimination of coarser silica particles has permitted slightly coarser raw grinding, and the consequent absence of uncombined silica in the clinker has reduced finish grinding costs about 10 per cent, even though the clinker is denser.

And the implications: they are many. For one thing, of the numerous types of cement materials, from all over the world, which have been tried in the process, not one has been found that did not yield to the treatment. Not only is it possible to raise the calcite content of the mix to any desired degree, but it also is possible to adjust the silica-alumina and silica-iron and alumina ratios, as in the case of plants using a high-lime material or an argillaceous limestone mixed with clay or shale. In one test of a clay, for example, it was possible to vary the first ratio anywhere from 2.66:1 to 9.42:1 and the second from 1.61:1 to 2.98:1.

Even more important is the fact that the process opens a way toward the production of other than ordinary cements. From the same raw material, with the addition only of a little iron ore to the mixes for the last two types, the company has also produced high-early-strength, sulphate-resisting and low-heat cements. Any other special types, presumably, could similarly be produced. One expedient toward this end is the further separation of the flotation rejects by means of the shaking table concentrator. Such rejects have been tabled, producing four fractions from the end, plus a slimes fraction from the side. Three of these fractions were high in silica-alumina ratio and could be used for correcting this factor, while one was high in alumina and another in iron.

One further prospect, the application of this system to dry process plants, has been under consideration. Although not fully developed, it appears likely that by air separation and flotation the process can be worked out so as to require no change in grinding or kiln equipment.

Equally interesting is the process now under development for the concentration of limestone for use in preparing high-grade lime. Unfortunately, this has not yet reached the point for discussion. Suffice it to say that, while the principles of the cement and lime processes are similar, technique differs markedly. In the first case, only enough of unwanted constituents is removed to correct the mix, while in the second, a nearly complete separation is necessary. That such a separation is possible, however, is evinced by the fact that lime concentrates have already been obtained, retaining only a small fraction of 1 per cent of impurities.

For their assistance in the preparation of this article, I am indebted to Messrs. Breerwood and Geo. K. Engelhart, and for the privilege of reviewing his paper before it was presented to the American Institute of Mining and Metallurgical Engineers on Feb. 18, to Prof. B. L. Miller, of Lehigh University, who collaborated with Mr. Breerwood in a publication of that society, entitled "Flotation Processing of Limestone." Information has also been gleaned from three sources to which the reader is referred, namely, Mr. Breerwood's U. S. Patent 1,931,921; his paper, "Mineral Separation Applied to Portland Cement Manufacture," presented before the Conservation Committee of the Portland Cement Association, Oct. 9, 1934; and an article by N. C. Rockwood appearing in *Rock Products,* August, 1934, pp. 32-37.

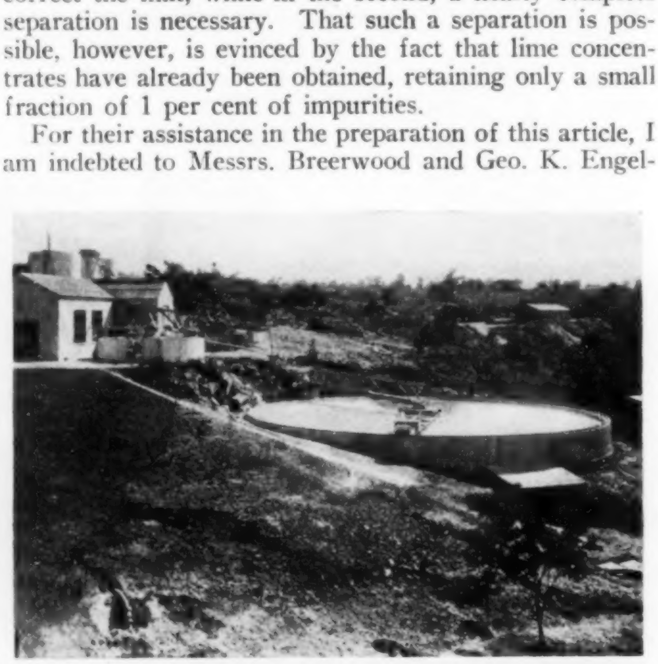


Fig. 11—Dorr traction thickener where the final mix is dewatered for kiln feed

Teaching the Application Of the Unit Operations

By H. McCORMACK

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This paper is addressed to the practitioner in chemical engineering and the employer of the future chemical engineer as well as to all in the field of chemical engineering education, requesting their influence in correcting an educational situation which should not exist. Teachers of chemical engineering have known that little laboratory instruction in chemical engineering worthy to be so called has ever been given. Much conversation and several symposia have been held. This is about all. Little improvement is, therefore, expected until forced by professional opinion. Bigger and better courses in chemical engineering applications can be given just as soon as the profession becomes insistent. —HARRY McCORMACK.

CHAOS reigns throughout the colleges and universities of the country in so far as they are concerned with teaching the practical applications of the unit operations of chemical engineering. The variation ranges from the school possessing no engineering laboratories and offering no such instruction, by various gradations, to the school having a well-equipped laboratory and devoting considerable time to application studies and demonstrations.

Uniformity of laboratory courses in chemical engineering is not to be advocated here nor is it believed to be desirable. The opinion is expressed, however, that uniformity of purpose and objective could and should be obtained. In this writer's opinion, these are as follows:

(a) First and foremost, a thorough working knowledge of the theories and calculations involved in the unit operations of chemical engineering. It is suggested that laboratory experiments offer the straightest and surest road to such knowledge. A student's appreciation of a theory increases as opportunity is presented to test it out experimentally and to find that even with the modicum of technique he may possess, the data secured compare closely with those suggested by theory.

(b) An understanding of the limitations in theories and calculations of chemical engineering. In other words, knowing what cannot be done on the basis of present knowledge, probably ranks next in importance to knowing what can be done. Once a student knows the futility of attempting to calculate, *a priori,* the flow of heat in a jacketed kettle, for example, a more definite understanding of the limitations of our knowledge exists.

(c) Cultivation of judgment as to the evaluation and interpretation of experimental data. Only a few experiments will develop the fact that, even with closely controlled operating conditions, the operating data secured have some variations. Judgment must then be exercised in determining portions of the data to be accepted, portions to be rejected, and the interpretation to be given that which is accepted.

(d) Familiarity with the current literature of chemical engineering. Each experiment should have a list of references to be read and digested. Other information not found in the cited references should be requested, making it necessary for the student to exercise his own ingenuity in a search of the literature. Knowledge thus gradually gained as to how and where to look for desired information is an acquisition of permanent value.

(e) The final objective is attained in the preparation of the required reports—first a preliminary report covering the literature of the topic being investigated, a description of the equipment to be used, and the experimental procedure; then the final report presenting data secured, calculations and deductions arising therefrom. Emphasis should be placed on the form and composition of the report as well as its scientific content. Instructions should be given on the preparation of an engineering report following this instruction and excellence in report preparation should be insisted upon.

Experiments with the unit operations divide into two types: (1) Engineering experiments in which the theoretical background and the experimental data secured permit the mathematical comparison of experimental values against those theoretically calculated. (2) Operating experiments in which, due to the impossibility of securing certain desired data or due to lack of fundamental information, such mathematical comparisons cannot be made.

An experiment in flow of heat, condensing vapor to liquid flowing in a horizontal pipe, would be illustrative of the first type of engineering experiment. Such data may be taken as enable one to compute the vapor film coefficient, the liquid film coefficient, the overall transfer, and to compare these with the same items experimentally determined. The operating experiment usually comprises study and operation of some piece of equipment. The data are essentially operating data and as such afford no opportunity to check experimental values against similar ones mathematically computed.

The flow of heat in a single effect evaporator belongs with the unit operations, yet is illustrative of this second type of experiment. Certain fundamental data, viz., the mass velocity of the liquid and the diameter through which it circulates, are lacking. The theoretical calculation of the liquid film coefficient is therefore impossible and there is no opportunity for securing a mathematical check on the experimentally determined film coefficients, except on the steam side.

It may be said, in general, that the operating experiment cannot be subjected to mathematical analysis without assuming a value for some item not experimentally determinable. For example, assuming a liquid film coefficient in the evaporator experiment will place the entire experiment on a mathematically calculable basis.

Another and important type of operating experiment consists in conducting some process, such as the pyrolysis of coal, on a pilot plant scale and obtaining experimental data on heat and material balances. Possibly the effect, as to product, of varying certain operating conditions is noted. There are several bases upon which data may be checked, but no possibility for any comparison between results obtained experimentally and those calculated mathematically.

Because each of these types of experiments has its distinct value from an instructional standpoint, a well planned course should contain the proper ratio of each. Usually the time allotted to the laboratory course and the existing laboratory facilities will be the determining factors.

With a comparatively short time allotted to the course, the engineering type of experiment should receive the heaviest rating and possibly, all of the selected experiments should be of this type. A longer time and a larger bank roll will offer the possibility of including all of the desired engineering experiments, a few operating experiments, and a considerable number of process experiments.

A series of experiments of the engineering type that have been presented in our laboratories for several years follows:

Engineering Experiments

(1) Fluid flow with a piston pump in the system.
(2) Fluid flow with a centrifugal pump in the system.
(3) Fluid flow by gravity.
(4) Use and comparison of fluid flow measuring devices.
(5) Flow of heat by radiation and convection to air in a pipe coil.
(6) Flow of heat by radiation and convection to water in a pipe coil.
(7) Flow of heat by conductance through furnace walls.
(8) Flow of heat condensing vapor to flowing liquid.
(9) Drying and humidity.
(10) Fractional distillation.
(11) Filtration with three types of filters.
(12) Gas absorption.

The absence of experiments relating to certain unit operations will be noted. For example, there are no experiments in extraction included among those of the engineering type because, to date, sufficient time has not been available for the development of such experiments nor has it been possible to find any such experiments in the literature in a form which seemed to be usable. Crystallization seems to require additional research, before it will be on such a basis as to afford the opportunity for developing satisfactory engineering experiments. Mixing, until recently, was in the same category as crystallization. Recent work by White at North Carolina, and by Hixon and associates at Columbia, presents material which may be satisfactorily worked over into laboratory experiments of the engineering classification. Crushing, grinding and size separation seem to require somewhat elaborate equipment involving considerable financial outlay, and then an extended study of this unit operation, before there is any possibility of developing engineering experiments in this particular operation.

The list of experiments of the engineering type may appear to be very limited, but attention is called to the possible variations which can be introduced in practically every experiment in the list. Some examples may be cited: The first three experiments, all in fluid flow, permit variations in size of pump, size and length of pipe lines, head to be overcome, kind of pipe and types of fittings in the lines. Experiment 5 permits the use of one of several gases in place of air, also variations in the size, shape, and location of the pipe coil, location, area, and temperature of the radiating surfaces, temperature and velocity of the convection currents. Water, in Experiment 6, may be replaced by any one of a score of liquids.

The furnace walls, used in Experiment 7, offer a wide variety of combinations. The condensing vapor and the flowing liquid in Experiment 8 may be any one of a score of different combinations. The liquids to be subjected to fractional distillation may be chosen from a long list. The suspended solid to be filtered may be any one of a hundred different materials and handled with widely varying concentrations, filtration pressures, and filter media. Gas absorption may be tried with any gas coupled with any absorption liquid, which offers considerable diversity.

Visualize the possibilities should twenty of the schools of chemical engineering install laboratory courses including these experiments and with agreements as to the particular variation to be operated, data to be exchanged, and as rapidly as substantiated, the data published. Only a few years would be required to extend enormously the boundaries of the existing knowledge of the unit operations.

A list of operating experiments, tried out from time to time in our laboratories, follows:

Operating Experiments

(1) The concentration of a solution or the evaporation of water in a vacuum pan.
(2) Same, in a single effect evaporator.
(3) Same, in a double effect evaporator.
(4) A study of crystal formation from various solutions.
(5) Particle size separation by screening.
(6) Particle size separation by washing.
(7) Extraction by diffusion with a solvent.
(8) Extraction by expression in hydraulic or screw press.
(9) Drying crystals in a centrifuge.
(10) Flow of heat, condensing vapor to flowing liquid, in a vertical pipe.
(11) Same, in an inclined pipe.
(12) Flow of heat in jacketed kettles.

Extended scrutiny of several of the experiments in this list will be required before they can be differentiated from those of the engineering type. Assurance is given that they do differ, this difference being that no experiment in the operating list can, with our present knowledge, be calculated theoretically and the results compared with those experimentally obtained.

Process experiments may be concerned with complete industrial processes or with the so-called unit processes as distinguished from the unit operations. The following is taken from both types as assigned from time to time to students in our laboratories:

Process Experiments

(1) Destructive distillation of wood.
(2) Destructive distillation of coal.
(3) Destructive distillation of oil shale.
(4) Fractional distillation of coal tar.
(5) Fractional distillation of crude oil.
(6) Refining the products from crude oil fractionation.
(7) Refining a vegetable oil.
(8) Production of a grained, kettle soap.
(9) Production of glucose from starch.
(10) Production of paper pulp from various cellulosic materials.

Nitration:—benzene to nitro benzene,
chlorbenzene to o- and p-nitro chlorbenzene.
Reduction:—nitro benzene to aniline,
o- and p-nitro chlorbenzenes to o- and p-nitro phenols.
Sulphonation:—benzene to benzene sulphonic acid,
benzene to m-benzene disulphonic acid,
naphthalene to 1:3:6 trisulphonic acid,
b-naphthol to G acid.
Esterification:—sodium formate to ethyl formate,
acetic acid to ethyl acetate,
anthranilic acid to methyl anthranilate,
aniline to diethyl aniline,
p-nitro chlorbenzene to p-nitro phenetol.
Alkali Fusion:—sodium benzene sulphonate to sodium phenate,
sodium naphthalene-b-sulphonate to b-naphthol,
sodium m-benzene disulphonate to resorcinol.

The recent publication of Groggins' "Unit Processes in Organic Synthesis" (see book review pages of this issue. Ed.) makes available, in easily adaptable form, much additional material for unit process experiments.

Long experience has convinced the writer that certain requisites should be kept in mind when working up the details of a laboratory experiment. The chief items of importance seem to be:

1. The experiment should be of such complexity as to tax, but not to over-tax, the ability and ingenuity of the average student.
2. It should be illustrative of material covered in the class room and as closely correlated to class room work as is physically possible.
3. It should be planned so as to supply opportunity for checking experimental results against theoretical calculations or against the results of industrial plant operation.
4. The necessary equipment must be such as is likely to be found in any well equipped laboratory, easily procurable from manufacturers' stock items, or such as can be constructed with moderate expense.
5. The operating setup must be as simple as possible and at the same time, accomplish the desired results.
6. The setup must be one which can be operated by average students with minimum repairs.
7. The experiment must be of such duration, or divisible into such portions, as to permit the completion of the entire experiment or one component part, in one laboratory period. This may sometimes require a full day devoted to the laboratory period.

What information should be supplied to the student is a question arising very early in the preparation of instructions covering chemical engineering laboratory, or any other laboratory work. It seems wise, before attempting to answer this, to repeat that this paper concerns itself with instruction for undergraduate students.

The student should have written instruction sheets stating: Most pertinent references; the equipment available for the experiment; the object to be accomplished by conducting the experiment; any specific questions the answers to which are desired in either the preliminary or final student report.

The value of supplying any references may be destroyed by supplying too many. They must be carefully selected, being sure that they cover the desired subject matter and that the content of the references presents the latest material available on this particular topic. References are of most value when divergent opinions are expressed so that it becomes necessary for the student to exercise choice as to which opinion to accept and in such instances, he should be expected to state his reasons for his choice.

Instructions must be carefully prepared to convey sufficient information without conveying too much. An instruction sheet telling a student all about an experiment which he is about to do, removes all his interest in doing it. On the other hand, imparting too little instruction leads to an unprofitable expenditure of the student's time as well as usually yielding no experimental results of engineering value and leaving in the student's mind a false impression regarding the particular theory or application of theory he is attempting to prove.

Our chemical engineering laboratories operated for a period of years on the basis of supplying the least possible amount of information. The educational and engineering results were both unsatisfactory. From year to year, more information was supplied until now the student is told definitely the object of the experiment; suitable equipment is described, usually with an accompanying sketch; and in one of the cited references is to be found a description of a similar experiment conducted by someone else, or if such material is not available, a concise description of the experiment is given in the laboratory instructions.

What Equipment and What Cost?

Much of the equipment for engineering experiments must be specially designed and constructed. It is not necessary that all setups for the same experiment be exactly the same. Certain fundamental features must, however, be employed. A study of the recommended equipment, preferably shown in a sketch, enables an intelligent instructor to use something he already has or to construct, with least expense, a piece of equipment which meets best his own conditions. The present status of our own laboratory experiments has been attained chiefly by what our students have told us in regard to design of equipment and operation of experiments.

The cost of equipment looms large in the mind of most colleges and universities contemplating the installation of such a course as has been discussed. Hoping for appreciation of this part of the paper at least, the writer prepared cost sheets for the equipment required for the entire list of engineering experiments, including the cost of all required indicating devices. Not included, however, are expenses involved in plumbing and pipe fitting beyond the equipment itself. The cost is $3,000. The cost of equipment for the operating experiments may run as high as your bank roll permits, but possibly not as low. The cost of the items required for the experiments listed in this class can be satisfactorily covered by an investment of $4,100. Process experiments, like operating ones, can cost anything you want to pay. The list given can be financed for $3,000. Do not make the mistake of building the process equipment so large there is only room for one or two processes in the laboratory or on the budget.

Properties and Applications of MODERN REFRACTORIES

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DEVELOPMENTS in the field of refractories manufacture during the last 15 or 20 years have been as rapid and far-reaching as the tremendous advances that have been made in many other industrial operations. However, with the increased diversity of types now available, an accurate understanding of the conditions under which the refractories are to be used becomes more important and the selection of the best brick for the purpose intended becomes less simple.

Many factors in the recently developed technique of refractory manufacture have an important bearing on the properties of the products. Power pressing, except for very special shapes, has largely replaced hand pressing, with consequent improvement in sizing, texture and other properties. De-airing, sometimes employed, has provided brick of improved character for many purposes. Slip casting, although more expensive than most production methods, is advantageous in certain applications, as is direct casting of the molten refractory material. Better understanding of sizing of the refractory particles and of the effects of firing under various conditions has contributed materially to improvement.

Chemical and Physical Properties

Of the various factors which determine the kind of refractory to use in a particular case, working temperature, rapidity and extent of temperature change, strength requirements, and the chemical reactions to be encountered are most important. The last may be one of the most fertile sources of refractory failure, with metallurgical slags, many fuel ashes, and products, such as molten metals, glasses and cement clinker, all vying in destructive chemical action. Various furnace gases have a deleterious effect, such as CO within a critical range of 420-470 deg C., on some kinds of brick, and SO_2, natural gas, hydrogen or steam, on others.

Chemical Properties—While the chemical compositions of the usual commercial refractories classify them in general groups—acid, basic and neutral—a sharp distinction cannot be made in all cases. Silica brick are decidedly acid and best suited to resist fluxes of an acidic character at high temperatures. Magnesite brick are strongly basic and chrome, high-alumina, and fireclay brick belong to the less precise neutral class. Among the fireclay brick are those ranging in silica content from 70 per cent or slightly higher to as low as 50 per cent. The high-alumina brick comprise those containing from 50 to 80 per cent alumina, or higher for some special brick. This is a wide range in the alumina-silica series of refractories and it follows that there also are great differences in their chemical reactions with various fluxes. In a given class of refractories, chemical analyses alone may not necessarily serve as good criteria of their chemical behavior, nor of their physical properties. The mineral compositions usually are more important and there are illustrations of this in succeeding paragraphs.

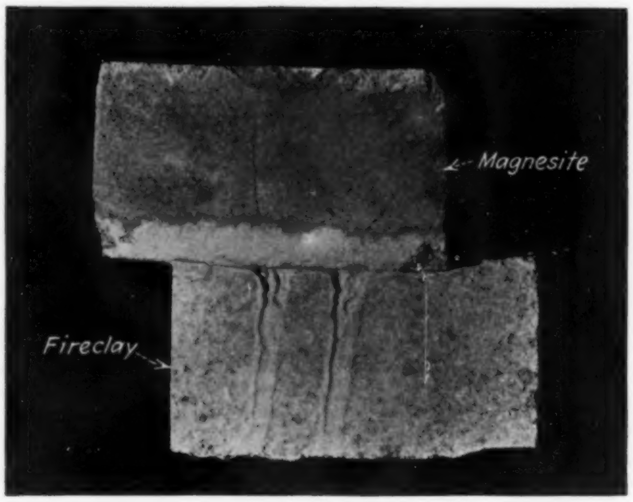


Fig. 1—Corrosion of bricks in contact, illustrated by magnesite and fireclay, held at 1,500 deg. C. for 22 hours

It is the rule rather than the exception that several classes of refractory are used in the construction of a furnace because one type of brick is better adapted than another to withstand the widely different conditions that prevail in various parts of some furnaces. In order to be assured of the best results from each kind of refractory used, it is necessary to guard against reaction between them. This can be done by the use of a separating course of brick or cement which has least tendency to react with either of the adjacent kinds of brick, or by designing the construction in such manner that the reacting bricks are in contact with each other in the cooler or in protected portions of the furnace.

The results of a very recent investigation to determine the temperature of reaction between different types of refractories is summarized in Table I. While these data are very indicative they would not accurately apply for all conditions. For a considerably longer period of heating than that of the test and as influenced by slags, reducing atmospheres or various gases, no doubt the temperature of reaction in some cases would be somewhat lower. Fig. 1 affords a good illustration of reaction between a magnesite and a high-heat-duty fireclay brick as heated in the test at 1,500 deg. C. for 22 hours. The fireclay brick underneath is corroded by the slag produced at the surface of contact and the effect upon the magnesite brick is apparent.

Porosity—The porosity of refractories is a very important property inasmuch as it has a direct bearing on many of the other physical properties and also upon resistance of the brick to chemical attack. The higher the porosity of a brick, the more readily and thoroughly is it penetrated by molten fluxes and by gases. When a brick becomes impregnated with a slag, chemical reaction can progress more rapidly because of the greater amount of contact surface or, if the particular slag does not happen to have a corrosive action upon the brick, the penetration nevertheless has a destructive effect. Mechanical penetration alone, when appreciable, often results in damage to the brick by causing the affected portion to swell and break by pinching.

Condensed from a paper presented by the author under the title of "Refractories and Their Applications" before the Pittsburgh meeting of the American Institute of Chemical Engineers, Nov. 16, 1934.

Table 1—Temperatures of Reaction Between Different Refractories*

(A, temperature at which reaction was first observed; B, temperature at which reaction first became damaging; N.D., not damaged; N.R., no reaction.)

Type of Brick	Silica A	Silica B	Fireclay A	Fireclay B	High Alumina (70% Al_2O_3) A	High Alumina (70% Al_2O_3) B	Chrome A	Chrome B	Magnesite (Low Iron) A	Magnesite (Low Iron) B	Magnesite (Regular) A	Magnesite (Regular) B	Forsterite A	Forsterite B
	Temperature, Deg. C													
Silica	......	......	1,500	N.D.	1,600	N.D.	N.R.		1,500	1,600	1,500	1,600	1,700	1,700
Fireclay	1,500	N.D.	......	......	N.R.		1,600	N.D.	1,500	1,500	1,400	1,500	1,500	1,600
High Alumina	1,600	N.D.	N.R.		......	......	1,600	1,600	1,700	N.D.	1,500	N.D.	1,700	1,700
Chrome	N.R.		1,600	N.D.	1,600	1,600	......	......	N.R.		N.R.		N.R.	
Magnesite (low iron)	1,500	1,600	1,500	1,500	1,700	N.D.	N.R.		......	......	N.R.		N.R.	
Magnesite (regular)	1,500	1,600	1,400	1,500	1,500	N.D.	N.R.		N.R.		......	......	N.R.	
Forsterite	1,700	1,700	1,500	1,600	1,700	1,700	N.R.		N.R.		N.R.		......	......

*From table by R. E. Birch, Am. Refract. Inst. Bulletin 52, Oct., 1934.

Note: Tests at 1,400, 1,500 and 1,600 deg. C. made in a gas-fired furnace heated at rate of 50 deg. C. per hour and held at maximum temperature in each case for 5 hours. Tests at 1,700 deg. C. made in coal-fired furnace heated up in 13 hours and held not over 1 hour.

It is a not uncommon assumption that brick of low porosities have high spalling tendencies. This does not always accurately apply, for brick of coarse grind and controlled grain size are made which have both unusually low porosities and high resistance to spalling. Within a given class the brick of lowest porosity generally are strongest and have highest thermal conductivities and greatest heat capacities.

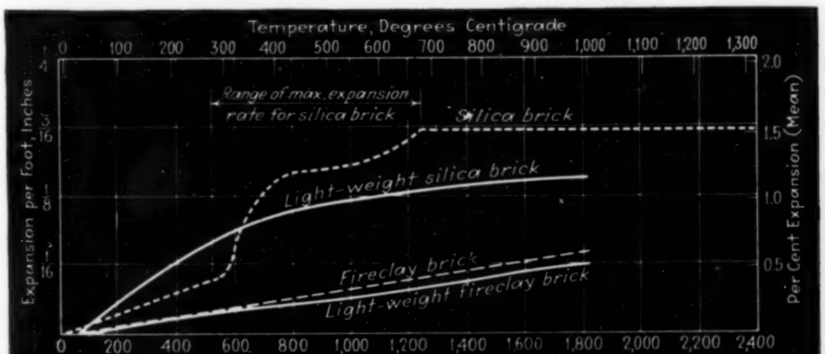
Fusion Point—Commercial refractories are essentially composites, usually consisting of several different minerals, both amorphous and crystalline, with small amounts of impurities which are principally basic oxides. Most of them soften gradually over a range of temperatures and do not have precise melting points. Fireclay and high-alumina brick soften over a rather wide but high temperature range. With silica brick the softening point is more sharply defined. The most satisfactory method of measuring this property of refractories is by means of comparison with pyrometric cones of predetermined softening points under definitely prescribed heating schedules; the values are most conveniently expressed as Pyrometric Cone Equivalents. The P.C.E. determinations of refractories which develop viscosity at high temperatures are considerably influenced by the duration of the heating.

Thermal Expansion and Permanent Volume Change—All refractory brick expand when heated. The expansion curves for various refractories differ considerably in the rates at which the expansions progress and in magnitude. In Fig. *2* are shown among others the curves for high-heat-duty fireclay brick and silica brick. Other factors being equal, the brick having the highest expansion and the least uniform rate of attaining maximum expansion are most susceptible to spalling when subjected to rapid heating and cooling.

In addition to the reversible expansion, refractories are subject to permanent volume changes when they are heated to temperatures high enough and for a sufficient length of time appreciably to alter their textures. Mineral inversions occur which are accompanied by either expansion or contraction as the case may be. Also, the softening of refractories causes shrinkage, while the development of an overfired vesicular condition results in swelling.

Strength—In by far their most extensive applications, refractories are required to sustain compressive loads. However, in many uses they are subjected to transverse stresses. Only in a relatively few cases are they subjected to tension or shear alone. Resistance to abrasion at high temperatures is an important requirement of refractories for many furnace constructions such as byproduct coke oven walls and linings of the discharge end of rotary cement kilns.

Fig. 2—Thermal expansions of various kinds of refractory brick



In most furnace constructions, as in walls and sprung arches, the major portion of the brickwork is comparatively cool and usually has more than ample strength to sustain the load. This is also the case but to a lesser degree when the furnace is insulated. For some conditions, when insulation is practiced, it is necessary to use a more refractory brick or one with greater strength at high temperatures.

Resistance to Rapid Temperature Changes—In general, brick which have the lowest thermal expansions and coarse textures are most resistant to rapid temperature changes. When a furnace is heated quickly a differential expansion occurs between the exposed face of the brick and the zone just a short distance back from the face. Naturally, strains develop which are most pronounced in brick having highest thermal expansions. Brick of coarse grind are slightly elastic or flexible; this aside from the development of plastic flow such as takes place in fireclay and high-alumina brick at high temperatures.

After brick have been in service for some time their properties are usually altered and their resistance to spalling likewise changes. They may become vitrified, impregnated with slags or weakened structurally by the influence of gases and are then more susceptible to spalling.

Inadequate allowance for the thermal expansion of brickwork results in pinching and rupture of the brick near the hot ends and this usually is interpreted as spalling. Excessive shrinkage or permanent expansion of the brick also account for a type of spalling.

Thermal Conductivity—The heat conductivities of most refractory brick increase with rise in temperature as also is the case with light-weight refractories and insulating brick, but for magnesite brick the opposite is true. This is illustrated in Table II by the conductivity values at several temperatures for a number of classes of refractory and insulating brick. In any individual class of refractories the densest and least porous brick have the highest thermal conductivities. Low heat conductivity is beneficial in most furnace constructions but generally it is not of great importance in comparison with other properties of the refractories and is seldom given consideration. When insulation is desirable, light-weight refractories or insulating brick or both are used as conditions permit.

High thermal conductivity is an especially desirable property of the refractories used for building retorts, muffles, byproduct coke oven walls and recuperators.

Heat Capacity—The quantity of heat that a unit volume of a refractory will absorb and discharge, at any given temperature over an interval of time until equilibrium is established, is a function of its thermal conductivity, specific heat and specific gravity. The low quantity of heat absorbed by the light-weight brick works greatly to their advantage when used in furnaces which are operated intermittently. The working temperature of the furnace can be attained with lower fuel consumption and in much shorter time than when it is built of fireclay brick. On the other hand, obviously, the least porous and heaviest fireclay brick are best for regenerator checkers.

Contradictory Properties and Applications—It frequently happens that advantage is taken in a very successful application of one property in which a refractory excels, while many or all the other physical and chemical characteristics of the brick seemingly are not well suited for the purpose. Outstanding examples are found in the use of silica brick, despite the fact that they are chemically acidic, in furnaces where they come in contact with strongly basic ma-

Table II—Typical Thermal Conductivity Values of Refractory Brick

Mean Temperature, Deg. F.	B.t.u. Per Hour Per Sq.Ft. Per In. Per Deg. F. Fireclay	Silica	Magnesite	Chrome	Forsterite	Light-Weight Fireclay	Light-Weight Silica	Diatomaceous Earth
500	6.4	7.9	34.8	10.5	12.4	1.98	1.76	1.08
1,000	7.8	9.8	30.0	11.2	11.1	2.34	2.60	1.39
1,500	9.2	11.7	26.2	11.6	10.7	2.72	3.41	1.70
2,000	10.7	13.6	24.0	11.8	10.4	3.10	4.25	2.00
2,500	12.1	15.6	23.0	11.9	10.3	3.48	5.10	....

terials. They are used in the roofs of copper reverberatory furnaces and in the caps of continuous glass furnaces for example, and serve the purpose, not only because of their good strength at high temperatures, but also because they do not become even slightly viscous at the furnace temperature and consequently, chemical action between the acid brick and the basic fluxes proceeds only very slowly.

Silica Brick

Silica brick are composed of hard, fine-ground quartzites with an addition of 2 per cent lime for the bond. They retain high strength and rigidity at temperatures close to their melting point. Unlike fireclay and high-alumina brick, they do not compress gradually under excessive loads at high temperatures, but fail abruptly by breaking.

The temperature range of the maximum rate of expansion for silica brick is indicated on the curve in Fig. 2. Over this range it is necessary to heat and cool silica brick gradually to avoid spalling, but above about 700 deg. C. they may be heated and cooled rapidly without any detrimental effects.

During the past several years power pressing has been extended to the manufacture of silica brick in many standard sizes. In addition to the unusually good workmanship, power-pressed silica brick have a very homogeneous texture virtually free from air pockets and molding defects. This method of manufacturing silica brick for any particular quartzite reduces the porosity and, of course, low porosity is a highly desirable property for resistance to slag penetration. The thermal expansion curve for the power-pressed brick is the same as that for the brick molded by hand or the gravity machine, all other factors, such as quartzite bond and firing, being the same.

Among the commonplace and most extensive uses of silica brick are those in open-hearth steel furnaces, by-product coke ovens, glass tanks, copper reverberatory and refining furnaces and electric steel melting furnaces. Some of their more or less unusual applications which are dependent upon special conditions are in the linings of vertical lime kilns and melting zones of cupolas and in open-hearth and glass-tank regenerator checkers.

Fireclay Brick

Of all the various classes of refractory, fireclay brick are used in the largest tonnages. They are well suited for the widest variety of applications and their cost favors extensive economical utility.

The chemical composition of fireclays varies between exceedingly wide limits. Some fireclays contain a great excess of free silica, while others have abnormally high alumina contents usually due to the presence of the minerals diaspore or gibbsite. Brick made from the siliceous clays containing low percentages of the usual basic oxide fluxes are more porous, remain more rigid at temperatures close to their softening points and have lower P.C.E. values than the high-heat-duty firebrick of the 40 per cent alumina class.

In very recent years a special type of fireclay brick has been developed which is measurably better in one or several of its properties than the regular high-heat-duty brick. This special refractory is more or less commonly referred to as a super fireclay brick. Brick of this type are made from very refractory clays or kaolins, specially selected, either with or without the addition of small amounts of minerals of high alumina content, such as diasporitic clays, kyanite or andalusite.

A concise comparison of typical data on the properties of high-heat-duty and super fireclay brick is outlined in the Table III. While the differences between the properties of these two types of firebrick seemingly are slight, they nevertheless are sufficient to account for a worthwhile difference in many furnaces where severe conditions prevail.

Table III—Comparison of High-Heat-Duty and "Super" Fireclay Refractory Brick

	High-Heat-Duty Brick	"Super" Brick
P.C.E., cone number	32 (1,700 deg. C.)	33-34(1,750-60 deg. C.)
Alumina, per cent	40.5	43.5
Porosity, per cent	18–24	12–18
Weight, lb. per cu.ft.	130–135	140–145
Contraction, per cent*	3–7	......
Contraction, per cent†	......	4–5

*Standard A.S.T.M. load test, 25 lb. per sq.in. at 1,350 deg. C.
†Special load test, 25 lb. per sq.in. at 1,450 deg. C.

Consistent with the high P.C.E. of the super fireclay brick the temperature of incipient vitrification is correspondingly high. In general, brick of this class far surpass the regular fireclay brick in resistance to thermal spalling, although some of them excel in their rigidity at high temperatures rather than in low spalling tendency. The super fireclay brick at a cost intermediate between those of regular fireclay and the high-alumina brick fills a need between these two classes and, in fact, is better adapted than either for some uses.

High-Alumina Refractories

Only within the last decade have high-alumina refractories become widely used in large tonnages. In a number of industries they are now regarded as the standard type of refractory for various parts of furnaces. This extended use of high-alumina brick is largely attributable to important improvements in their qualities and to the growing demand for refractories that can reasonably withstand the increasingly severe conditions for which fireclay and silica brick are no longer adequate.

The high-alumina brick which are used in largest quantities are those made principally from diasporitic clays. Bauxite sometimes is used, but to a far less extent. High shrinkage upon firing is an inherent characteristic of these minerals. The prefiring of a large portion of the brick mixture at high temperatures has been an important factor in securing satisfactory stability of volume of the brick in service. Grain sizing and molding under high pressure have also contributed much to the improved physical properties of the brick, such as low porosity, strength, low shrinkage and resistance to spalling.

The degree to which the desirable inversions to mullite ($3Al_2O_3 \cdot 2SiO_2$) and corundum are developed in high-alumina brick is dependent upon the heat treatment they receive during firing and in service.

Some special high-alumina brick are made of mixtures containing fused alumina. Generally these have the outstanding property of ability best to sustain loads under conditions of soaking heat at high temperature and are well suited for building muffles and piers.

Minerals of the kyanite group ($Al_2O_3 \cdot SiO_2$) corresponding chemically to 62.9 per cent Al_2O_3 and 37.1 per cent SiO_2 are used for manufacturing brick of high-alumina content which find their widest application in glass tanks.

A list of P.C.E. values and typical chemical analyses of the various commercial grades of high-alumina brick, made largely from diasporitic clays, appears in Table IV.

An especially interesting property of high-alumina brick is their behavior in various furnace atmospheres which have a detrimental effect upon most refractories. Many high-alumina brick consisting mainly of diaspore are practically inert to the disintegrating influence of carbon monoxide at the critical temperature range of 420 to 470 deg. C. and they are not disintegrated by natural gas atmospheres (unburned) at temperatures up to 1,000 deg. C., which was the highest temperature employed in a recent investigation (Ruprecht, Pierce and Harvey, *J. Am. Ceramic Soc.*, Vol. 18, July, 1934). Sulphur dioxide weakens them to a lesser degree than it does fireclay brick.

Table IV—Analyses of High-Alumina Refractories

	High-Alumina Class, Per Cent			
	50	60	70	80
Al_2O_3, per cent	51.5	60.8	70.6	79.4
SiO_2, per cent	41.9	33.3	22.8	15.8
TiO_2, per cent	2.7	3.0	3.7	2.1
Fe_2O_3, per cent	1.8	1.7	1.8	1.7
CaO, per cent	0.1	0.2	0.2	0.2
MgO, per cent	0.5	0.3	0.3	0.3
Alkalies, per cent	1.2	1.1	1.0	1.0
P.C.E., cone number	34–35	36–37	38	39
Temperature equiv., deg. C	1,773	1,815	1,835	1,865

One of the most extensive uses for high-alumina brick is in the portland cement industry, where they have supplanted fireclay brick for burning or clinker zone linings at most plants. The use of the 70 per cent alumina class is regarded as the most economical at a majority of the mills. Another very successful application of high-alumina brick and especially those of the 70 per cent alumina class is in the calcining zones of rotary lime and dolomite kilns. At many kraft paper mills the lime sludge from the recausticizing process is reclaimed by calcination in rotary kilns and brick of the 60 and 70 per cent alumina classes have proved best for the linings of the zones in which the highest temperatures prevail.

In many boiler furnaces the greatest contributing factor to the destruction of the brick setting is fluxing by corrosive slags from the ash of the fuel. The excellent resistance of high-alumina brick to the chemical action of fuel ash of high basic oxide content accounts for their successful application in such boiler settings.

In the glass industry, high-alumina brick supply a need for refractories that withstand the more severe condition attending the generally increased efficiencies of the present day and higher tonnages produced per unit of melting area. Their use in tanks for port and regenerator wall construction and as checkers has extended rapidly in very recent years. Other interesting applications of high-alumina refractories are in roofs of lead softening furnaces, crowns of silicate of soda furnaces and regenerator checkers of blast furnace stoves.

Basic Refractories

While magnesite brick have the highest fusion point of all the commercial refractories which are used in large tonnages, it is primarily because of their basic character that they are used in most of their applications. Yet it is not always practicable to take advantage of their high resistance to basic slags, since other of their properties may preclude their successful use where excessive spalling influences prevail or in those constructions where they would be required to sustain heavy loads at high temperatures. The thermal expansion of magnesite brick is uniform, but it is relatively high, attaining a maximum of about $\frac{7}{32}$ in. per foot at 2,400 deg. F. A peculiarity of magnesite brick, as compared with other refractories, is that the thermal conductivity of magnesite decreases rather than increases with rise in temperature as is illustrated in Table II. The magnesia content of the standard magnesite refractory is approximately 83 to 85 per cent, the major portion of which is present in the most stable crystalline form, periclase.

Magnesite refractories are used in largest quantities for open-hearth furnaces in the steel industry. In nonferrous metallurgical operations their most extensive applications are for lining copper converters, for the construction of parts of copper reverberatory and refining furnaces and for side walls in lead softening and byproduct furnaces. Dead-burned grain magnesite is practically identical in chemical composition with that of the brick and its most extensive use is for making sintered bottoms in open-hearth and electric steel melting furnaces.

During the past seven years "low-iron" magnesite brick containing 2 to 4 per cent ferric oxide and 90 per cent or more magnesia have been used in appreciable quantities for certain purposes. As compared with the standard type of magnesite refractory, the brick of low-iron content are stronger at high temperature, have lower spalling tendency and a better constancy of volume when subjected to long-continued heating at high temperatures. Several unusual but interesting applications of the "low-iron" magnesite brick are in the crucibles and walls of carbon bisulphide furnaces, rotary lime-sludge kilns and litharge furnaces. The fullest benefits of the properties in which the low-iron magnesite brick excel are secured from their use in exposed parts of furnaces where basic brick are best suited because of their resistance to slag, but where conditions are such that excessive spalling or shrinkage of other types of magnesite brick would take place. Among numerous diversified applications "low-iron" magnesite brick are used with splendid results in the exposed walls of certain basic electric steel melting furnaces, in the side walls of copper refining furnaces and to some extent in copper converters, particularly for lining tuyere sections.

Chemically bonded magnesite brick containing a relatively small percentage of chrome are advantageously used where certain operating conditions induce spalling, especially over moderately high temperature ranges. The unburned, chemically bonded brick are marketed at a

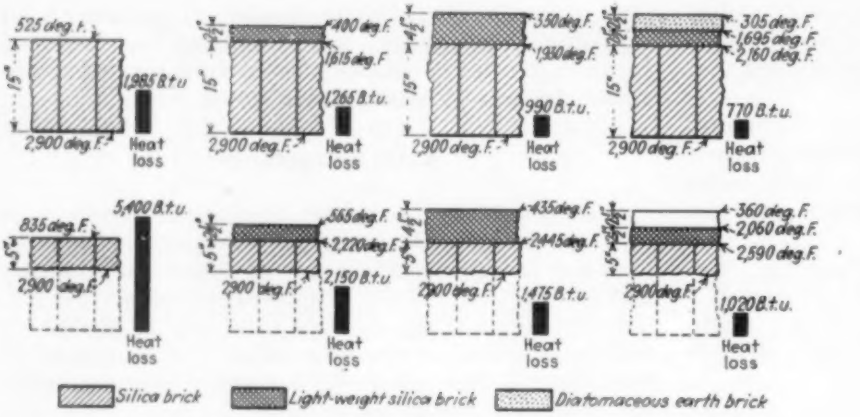


Fig. 3—Effect of wear on theoretical heat loss, in B.t.u. per square foot per hour, in insulated and uninsulated silica brick roofs

lower price than that of the standard magnesite brick fired at high temperatures.

Metal-encased, chemically bonded magnesite brick are much more resistant to spalling conditions at all furnace temperatures than are standard magnesite brick. These brick, provided with steel casings, are generally laid as headers, so that the brick are completely enclosed with steel except at their ends. The metal at the face oxidizes and melts and then reacts with the magnesite to form a monolithic face. At a short distance from the hot face the steel remains intact and serves to increase the spalling resistance and the strength of the entire structure.

Chrome brick of greater strength at high temperatures and greater spalling resistance are improvements resulting from advances in manufacturing methods. This refractory finds its most extensive use in parts of open-hearth steel furnaces. At many paper mills it is used with good economy in the soda recovery furnaces.

Insulating Brick and Light-Weight Refractories

Insulating brick may be grouped into two general classes: those suitable as backing for regular refractory brick and those which may be used in place of regular refractory brick where conditions permit. The latter are known as light-weight refractories.

Most brick of the former class are manufactured from diatomaceous earth. The light-weight refractories usually are similar in composition to the corresponding heavy refractories. However, the lower densities of the light-weight refractories and their consequent higher insulating values are the result of manufacturing technique. While no precise classification as to insulating value or temperature range can be made, diatomaceous earth brick having thermal conductivities, such as those cited in Table II, are not ordinarily suitable for temperatures above 2,000 deg. F. A type of light-weight refractory made of fireclay can be safely used for temperatures up to 2,500 deg. F. Light-weight silica brick are useful to 2,950 deg. F.

Brick of the diatomaceous earth type have been widely used for a number of years back of refractory brickwork.

Light-weight brick are substituted to good advantage for composite settings consisting of regular refractories backed with insulating brick in constructions where they will not be subjected to severe mechanical abrasion or to the effect of slagging action. The heat capacity of the light-weight brick is less than that of regular refractories of corresponding composition approximately in the ratio of their relative densities. When insulation is used back of the refractory the mean temperature of the refractory is raised and the difference between its heat content and that of light-weight refractory construction is further increased. The heat capacity of the refractory setting is often a significant item in the heat balance of furnaces which are operated intermittently.

Applications of the light-weight brick in heating and annealing furnaces, enameling ovens, hot-gas pipe lines, and dryers are typical. In these uses the light-weight brick are ordinarily laid and coated with a mortar especially adapted to the purpose in order to reduce their permeability to gases. Thermal expansion is provided for at the proper rate and in the same manner as with other refractories.

In Fig. 2 are shown the relative thermal expansions of light-weight fireclay and silica refractories in comparison with regular fireclay and silica brick. The thermal expansion of the light-weight silica refractory is materially lower than that for regular silica brick, which, in part at least, accounts for the fact that its spalling tendency is somewhat lower than that of silica brick.

Since the light-weight refractories are suitable for use at somewhat higher temperatures than are diatomaceous earth insulating brick, they are also frequently used for backing up refractory settings where the temperatures at the interface would preclude the use of less refractory materials.

To illustrate one such application of the light-weight silica, Fig. 3 is included. This is a case of the insulation of an open-hearth-steel furnace roof where the safe temperature range for the diatomaceous earth type of brick would be exceeded. The black bars indicate the relative heat losses through an uninsulated roof and through roofs with three successively increased degrees of insulation, and emphasize particularly the better constancy of the heat requirements of an insulated furnace as the roof brick are worn thin in service. The maximum safe working temperatures for the insulating materials are not exceeded in any case and since the light-weight silica brick are of the same composition chemically as the roof brick, any possibility of reaction between the roof brick and the insulation at high temperatures is definitely eliminated. Accordingly, the salvage of the insulation after a complete campaign is unusually high.

As the result of using only a $2\frac{1}{2}$ in. thickness of light-weight silica brick over the roofs of open-hearth steel furnaces, fuel savings conservatively estimated at 15 per cent have been reported in addition to the increased efficiency resulting from a more rapid melting of the heat.

With the insulated constructions shown in Fig. 3 the entire thickness of the roof brick is above that temperature range in which the most abrupt expansion of regular silica brick occurs, which consequently effects a more uniform distribution of stresses over the entire roof and the extremes in temperature which are found in uninsulated roofs are avoided.

Pulp and Paper Industry Developments

EDITORIAL STAFF REPORT

THE twentieth annual meeting of the Technical Association of the Pulp and Paper Industry was held in New York, the week of February 18. The 85 papers were concerned with management under the NRA and the various problems of the pulp and paper mill engineers.

The convention opened on Monday morning with a general session at which Pres. C. C. Heritage addressed the assemblage and Sec. R. G. Macdonald presented his annual report. This session was followed by group meetings on management, pulp testing and coated paper. Judson A. DeCew, president of Process Engineers, presented a paper on special types of rosin size and their physical properties.

As the character and stability of rosin size is affected by the time of boiling and the temperatures used and as its properties are different, depending upon the type of cooker used and the amount of circulation during the boiling process, it is necessary that once a particular type of size is accepted by the buyer, it should be duplicated with every shipment. The chief difference in the types of prepared size on the market is in the grade of rosin used and the degree of stability of each size, which property is affected by special conditions.

The use of adhesives for laminating operations was the subject of a paper presented at another session by Russell Morehouse of the engineering department, Philadelphia Quartz Co. He stated that vegetable adhesives, such as potato starch, were used during the infancy of the industry. A desire to operate more economically, and at higher machine speeds, led to improvements in fabricating equipment and the subsequent use of adhesive silicate of soda, which was better adapted to the rapidly changing conditions. Improved starch adhesives made from corn have more recently entered the laminating field for solid fiber.

Adhesives

A wide variety of silicates of soda is commercially available, but the requirements of laminating operations rather definitely fix the specifications of adhesive silicates suited to this type of work. Such silicates may be described as water solutions having an $Na_2O : SiO_2$ ratio approximating 1:3.25. The specific gravity of such solutions will be found to extend from a minimum of 1.37 to a maximum of 1.42. The corresponding viscosities will have 115 centipoises absolute as a minimum and will extend to a maximum of 785 centipoises absolute. These silicate solutions are of a light or medium syrup-like consistency. They have but little tack, flow readily and set, or form a bond, quickly by the loss of small quantities of water.

The starch adhesives are also water solutions which may be neutral or slightly alkaline. These adhesives have specific gravities which may approximate 1.135 to 1.14 with corresponding viscosities which are too great to measure with ease at ordinary temperatures. These adhesives also set, or form a bond, by the loss of water, but, unlike the silicate adhesives, they are tacky, and remain tacky in the adhesive film for a relatively long time, forming their bond more slowly than the silicate adhesives.

Results of a study of the causes of limited life of fourdrinier wire were reported by F. G. Wheeler of Kimberly Clark Corp., N. B. Pilling and F. L. LaQue of International Nickel Co. The factors that determine the behavior and life of fourdrinier wire are so many and so complex that the authors found it impossible to discuss them all or to estimate their relative importance. However, some of these factors, such as mechanical stresses and the effect of wear or stress, seemed capable of analysis. Photomicrographs showed that longest wire life may be expected from wires of uniform crystal size.

D. Manson Sutherland, consulting engineer, discussed the effects of refining action. Attention was called to the need for simplification of terms used in stuff preparation and suggestions were made for the same. Refining action on pulps changes the fiber size, shape and flexibility; these changes can be determined by classification or screening tests. Fiber size, shape and flexibility obtained by refining action are affected by the chemical and physical properties of the basic raw material or pulp.

Steam Accumulators

At the symposium on heat and power, D. K. Dean and G. M. Cameron of Foster Wheeler Corp. presented a paper on the use of steam accumulators in paper mills. The storage vessel, or accumulator, is designed to store between certain pressure limits, the amount of steam required to stabilize the load. The charging and discharging of stored steam is so controlled that charging takes place only when the steam supply from the boilers exceeds the demand for steam and discharging occurs only when the steam demand exceeds the supply from the boilers. The boilers are operated at a rate which will produce the average plant demand. The success, as well as the need for steam storage in paper mills is evidenced by the fact that more than 160 paper mills have installed steam storage systems.

During the symposium on acid pulping, Oscar E. Anderson, sulphite superintendent at the Chisholm mill of the International Paper Co., analyzed some of the sulphite mill problems. He stated among other facts that by reducing the speed of the chipper from 300 to 200 r.p.m. it was possible to reduce the quantity of chipper waste by $1\frac{1}{2}$ per cent of the wood consumed. This amounts to an annual saving of $4,950. The amount of wood per digester is usually dependent on the following factors: (1) Whether digesters are completely empty of pulp before filling, and completely full of chips after filling; (2) natural packing due to moisture content and specific gravity of chips; (3) forced packing of chips; and (4) length of chips or amount of large chips and slivers present.

Space permits mentioning only a few of the many worthwhile papers that were presented at the four-day session of the engineers of the pulp and paper industry.

Refining Lubricating Oils by Solvent Extraction

By J. V. HIGHTOWER
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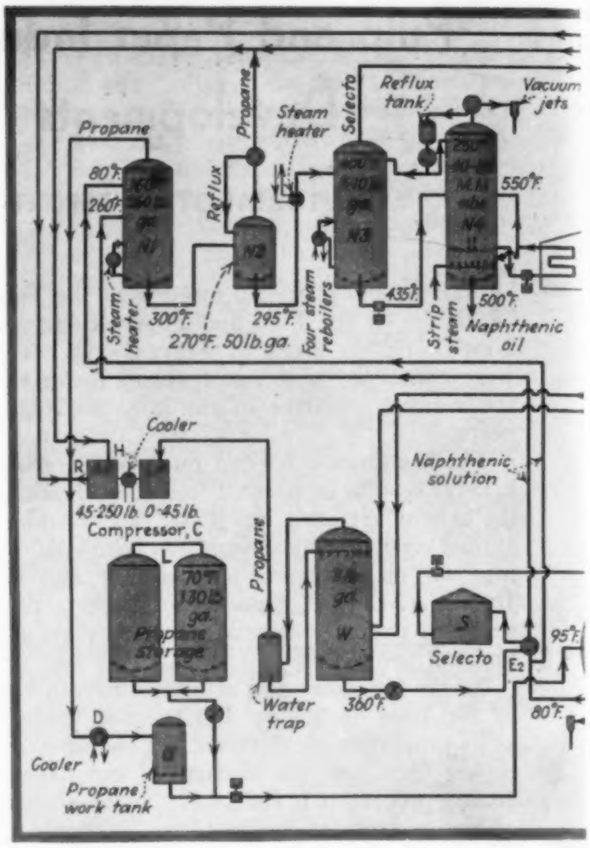


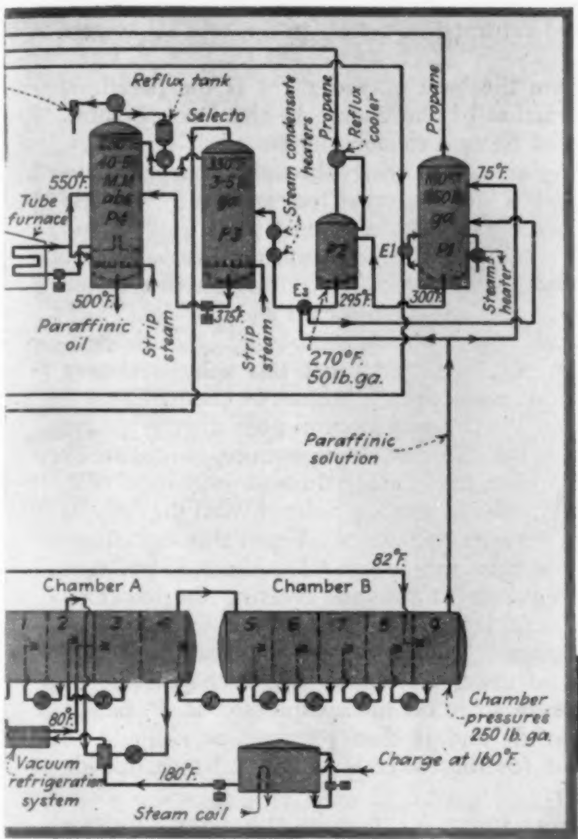
OF RECENT INTEREST in the petroleum refining industry is a process for the manufacture of lubricating oils from heavy stocks, both residuals and distillates, by means of a double solvent extraction that separates the stable from the unstable petroleum fractions. Magnolia Petroleum Co., at Beaumont, Tex., has been operating for several months one of the four Duo-Sol plants now producing or under construction in the country. The basis of this process was a series of test runs on a four-barrel unit in the laboratories of the Max Miller Engineering Co. of New York. From this small-scale development work has emerged the new solvent system. As a departure from the refining of lubricating stocks by the use of sulphuric acid the Magnolia's installation for the production of low-carbon residue, high-viscosity index, low-sludging lubricants is one of the late developments of the industry. One of the numerous advantages claimed for this plant is its ability to produce high-grade paraffin lubricants from untreated heavy residuals which, under the practice of numerous refineries, would be thrown into pressure-still cracking stock or used as fuel oil.

To date the company has been operating on an Oklahoma crude oil residual having a gravity of about 23 A.P.I. The refinery expects, however, to utilize other residuals as well as some distillates. The normal charging rate to the Duo-Sol unit is 2,000 bbl. per day and the paraffinic lubricating stock is produced at the rate of 1,500, while at the same time the production of the naphthenic oils removed from the charging stock amounts to 500 bbl. Oil recoveries total practically 100 per cent. The recovery of solvents is also virtually complete, solvent losses amounting to only a few tenths of a per cent. Tests on the charging stock and products obtained, and sources and characteristics of the two solvents used in the process, are given in Table I.

The basic principles of the process are simple. They embrace a solvent separation of the oil into two portions, one being the paraffin lubricating fraction, which dissolves in propane, and the other the naphthenic fraction, which dissolves in a coal-tar product called Selecto. This product as used at the Magnolia refinery consists of about 63 per cent cresylic acid, the remainder being primarily phenol. The separation is physical and is in this respect basically different from the chemical action involved in the sulphuric acid method of producing lubricants. Furthermore, the Duo-Sol process is continuous, the unit operations of mixing, separating and recovering of solvents taking place simultaneously.

After filtering through clay and dewaxing, the paraffin fraction is an acid-free lubricating oil which requires no further treatment of a physical or chemical nature to make it meet the requirements characteristic of high-grade lubricants adaptable to the modern high-speed, high-compression automobile. When the naphthenic oil and other undesirables have been freed from the solvents they may be incorporated into asphaltic materials or fuels, or devoted to other uses.

Reference to the flowsheet showing the essential features of the installation at the Magnolia Petroleum Co. indicates the paths taken by the charging stock, solvents, and products, as well as pressure and temperature conditions at various points. The data represent average operations for an Oklahoma City crude-oil residual. For the sake of clarity, many of the miscellaneous pipe lines have been omitted from the flowsheet, for instance those for the collection of non-condensable gases, cooling



Above—Flowsheet of the Duo-Sol process plant of Magnolia Petroleum Co., Beaumont

Auxiliary equipment consists of Croll-Reynolds two-stage vacuum jets on towers N4 and P4 and three-stage vacuum jets on refrigeration system; Braun and Westinghouse heat exchangers; Tagliabue flow and liquid level controls; Tagliabue and Crosby pressure gages; Brown recording thermometers; Mason-Neilan and Taylor pressure regulators; Clark double acting propane compressors; National Transit, Union, Gould, Worthington, Ingersoll-Rand, Quimby pumps — centrifugal, rotary, piston.

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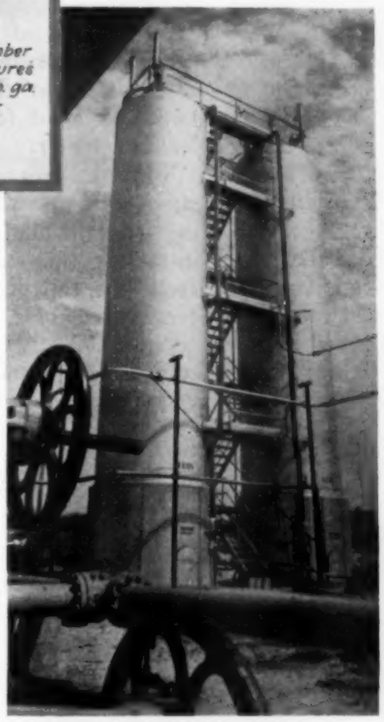


Propane towers in a solvent process unit at the Socony-Vacuum refinery at Paulsboro, N. J.

water, and steam. Means exist for maximum utilization and recovery of everything entering and leaving the system.

As the charge contains considerable paraffin wax it is first preheated by circulating through a tank equipped with steam coils. From this tank the charge is pumped to a mechanical mixing chamber where the heavy oil is added to portions of oil and solvent from compartments 2 and 4 of extractor chamber *A*. The function of this mixing is to bring about the separation and also to dilute the charge to a point where the wax in the charge does not solidify in the 252-ton capacity vacuum refrigerating system. Refrigeration is used to lower the temperature of the charge before it enters the extractor chambers.

Separation of the oil into the paraffinic and napthenic fractions begins when the charge enters compartment 3 mixed with the solvents. Propane enters compartment 1 of chamber *A* at a rate of about 90,000 lb. per hr., with a normal charge throughput of 2,000 bbl. per day, or approximately 27,000 lb. per hr. Selecto enters compartment 9 of chamber *B* at a rate of about 110,000 lb. per hr.

In compartment 3 the charge, already mixed with the heavy Selecto-naphthenic fraction pumped from the bottom of compartment 4 and the light propane-paraffin fraction from the top of compartment 2, separates into paraffinic and naphthenic oil layers by selective solution and gravity separation. The lighter, or propane-paraffin solution, is drawn over successively through compartments 4, 5, 6, 7, 8, and 9, while the heavier, or Selecto-naphthenic solution is pumped successively through the extractor compartments, in countercurrent to the upper layer. The separation is not perfect, as some Selecto passes along with the propane solution while some propane remains in the Selecto solution. The complete separation of solvents is accomplished later in the solvent recovery system.

The extraction phase of the process is completed when the Selecto - naphthenic solution emerges from the bottom of compartment 1 and the propane-paraffin solution from the top of compartment 9. The next phase is that of solvent recovery. There is a close similarity between the two groups of evaporation towers to the right and left of the tube furnace. These two groups perform similar functions. The left-hand group separates from the naphthenic oil the Selecto and the small quantity of propane present. The right-hand group removes from the paraffinic oil the propane and also the small quantity of Selecto present.

When the propane-paraffin solution leaves the top of compartment 9 a portion of it is pumped through a heat exchanger, *E*3, to receive heat from bottoms flowing from tower *P*2 to tower *P*3. The remainder is pumped directly to tower *P*1 to which point the preheated portion of the propane-paraffin solution is also conveyed. Tower *P*1 is an evaporator removing about 96 per cent of the propane in the solution leaving the extractor.

Heat is provided by an outside steam reboiler and by a heat exchanger, $E1$, taking heat from vapors from the top of tower $N3$.

Propane evaporated from the oil in tower $P1$ combines with that separated from the oil in tower $N1$ and the whole enters at R the discharge side of the two-stage compressor C, then it is cooled in the water cooler D, before being returned as a liquid to the propane work tank G.

Bottoms from tower $P1$, consisting now principally of paraffin oil, flow by difference of tower pressures into tower $P2$, a flash vaporization tower where an additional 2.3 per cent of the propane left in the original solution from compartment 9 is removed. Propane flashed from tower $P2$, combined with that flashed from tower $N2$, enters the high-pressure side of the compressor at H, passes through the water cooler, and is finally returned as a liquid to the propane work tank.

Bottoms from tower $P2$, after giving up heat in exchanger $E3$, are passed through two steam condensate heaters and are then discharged into tower $P3$, where most of the Selecto left in the oil is evaporated. Stripping steam is supplied by an open steam spray in the base of the tower. Vapors from the top of tower $P3$, consisting of Selecto and some steam and propane, pass to tower W, where the Selecto used in the system is stripped of water and propane before being returned to the tank, S.

Bottoms from tower $P3$ are pumped to a pan in tower $P4$. This tower is used for removing the final traces of Selecto and water from the oil. To facilitate this removal stripping steam is used at the base of the tower. Heat is furnished by circulating the oil from the base of the tower through a Lummus gas-fired furnace equipped with 3-in. heater tubes. A tower absolute pressure of between 40 and 50 mm. is maintained by the use of a two-stage vacuum ejector or jet pulling from the top of the tower as shown. Vapors from the top are condensed and returned as reflux to the tops of towers $P3$ and $P4$.

The oil from the base of tower $P4$ is the paraffinic lubricating fraction of the charge to the Duo-Sol unit. Only a trace of Selecto remains in the oil at this stage. After filtering and dewaxing through Sharples centrifuges the oil is dry, Selecto-free, and ready for use as a lubricant. It possesses a distinct greenish cast and shows a rich shade of red by transmitted light. Table I gives results of tests made on the oil after it leaves the unit and also after it has been filtered and dewaxed.

Turning now to the treatment given the Selecto-naphthenic mixture it is seen that this solution leaves the extraction system from the bottom of compartment 1 in chamber A. Part of the solution goes directly to the top plate of tower $N1$ at a temperature of about 80 deg. F. The other part passes through exchanger $E2$, where it is preheated by the hot Selecto from the Selecto dryer W, on the way to tank S. From this exchanger the solution continues into tower $N1$. About 86 per cent of the small quantity of propane entering the tower as a result of imperfect separation in the extractors is taken off overhead. This propane combines with that from the top of tower $P1$, enters the discharge side of the high-pressure stage on the compressor at R, passes through cooler D, and is then returned as a liquid to tank G. Heat for the tower is provided by an outside steam reboiler.

Bottoms from tower $N1$ flow by difference of pressures into tower $N2$, a flash vaporization tower removing from the oil an additional 12.5 per cent of the propane in the solution entering tower $N1$. The propane flashed from the top of tower $N2$ combines with that flashed from tower $P2$, enters the high-pressure side of the compressor at H, passes through the water cooler, and returns as a liquid to the propane work tank.

Bottoms from tower $N2$, after passing through a steam heater T, are pumped upon a plate of tower $N3$, where the bulk of the Selecto is evaporated. After condensing in the heat exchanger on tower $P1$ the vapors flow into the Selecto drying tower W. Heat is supplied to tower $N3$ by four outside steam reboilers, only one of which is shown on the flowsheet. Selecto and water condensing from the top of tower $N4$ are returned to the top of tower $N3$ as reflux.

Bottoms from tower $N3$ are pumped to a plate of tower $N4$, where the remainder of the Selecto in the oil is removed with the aid of an open steam spray. An absolute tower pressure of between 40 and 50 mm. is maintained by the use of a two-stage vacuum ejector pulling from the top of the tower. Heat is supplied this tower by circulating bottoms through a bank of tubes in the furnace.

Duo-Sol plant of the Magnolia Petroleum Co. at Beaumont, Tex. Propane storage towers on the right

Duo - Sol process has unique advantages in both the simplicity of refining operations and in the increased yield of high-quality finished oils. These advantages are obtained in the process through the application of a new method of solvent extraction. Instead of employing a single solvent, or solvent mixtures, which are selective of naphthenic oils, two solvents are employed

▼

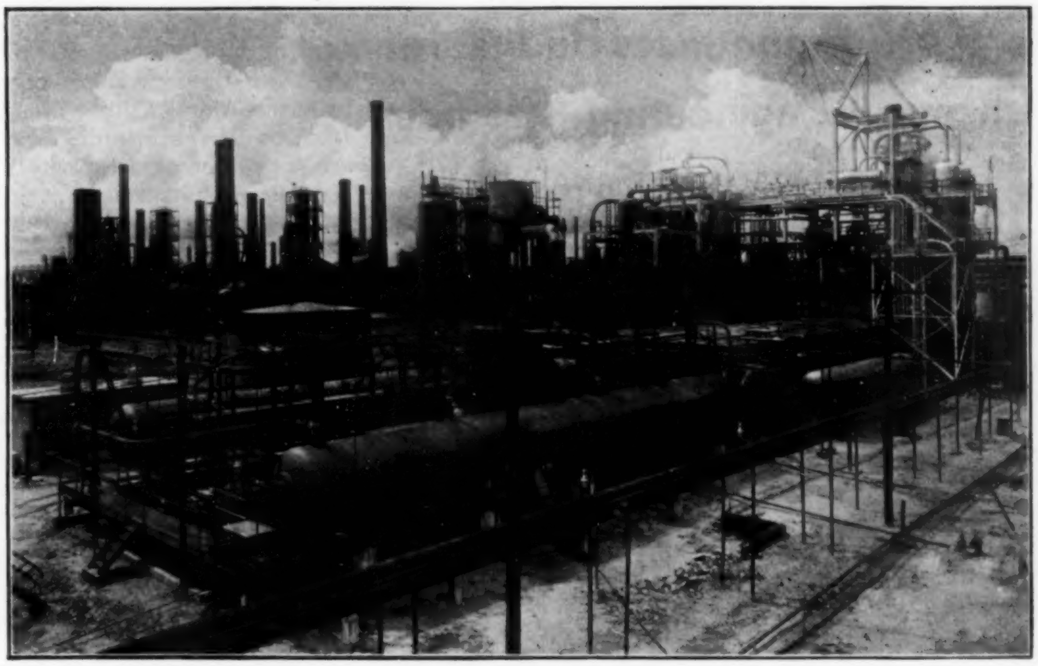


Table I—Charging Stock, Products and Solvents Data

	Charging Stock	Naphthenic Oil	Paraffin Oil From Unit	Paraffin Oil Dewaxed and Filtered	Propane	Selecto
Gravity, A.P.I.	23	7.5	30	29	....	1.05 sp. gr.
Flash, °F	460	500	450	450	....	......
Viscosity at 100°F	.....	....	......	658	....	......
Viscosity at 210°F	110	135 Furol	75	75	....	......
Viscosity index	....	....	......	100	....	......
V.G.C.	0.844	....	0.800	0.803	....	......
Color, N.P.A.	....	....	8	5	....	......
Pour, °F	90	....	90	0—20	....	......
Carbon residue, per cent	....		......	0.25	....	......
Acid content, per cent	....	below 0.1	below 0.05	.....	....	......
Purity, per cent	....	....	......	.....	97.0	......
Cresylic acid, per cent	....	....	......	.....	....	63
Phenol, per cent	....	....	......	.....	....	37

The oil from the base of tower $N4$ is that portion of the charge comprising the naphthetic and other undesirable oils. It goes to storage dry and practically acid-free as a black, heavy oil. Table I shows results of tests made on the product. Blended with other heavy materials it may be used as an asphalt, or it may be mixed with lighter oil and utilized as a fuel.

The characteristics of the paraffin lubricating oil obtained by the Duo-Sol process are controlled by several factors. One, of course, is the nature of the charge. Another is the relative proportions as well as the quantities of the two solvents employed in the process. Greater quantities of propane relative to the charge produce a better color, but affect the viscosity qualities of the oil adversely. The V.G.C. (viscosity-gravity constant) becomes smaller as the ratio of Selecto to propane increases. The temperature at which the extraction is carried out is another important factor that must not be overlooked.

Exactness in control of rates, temperatures, and pressures at all points in the process is regarded as essential. For instance, the water content of the Selecto must be kept low, as water in the Selecto pumped to the extractors would have an adverse effect on the V.G.C. and the color of the lubricant. As a result of the requirement of exact control a feature of the process is the extensive use of temperature, pressure, flow, and liquid level controls and indicators. Approximately $40,000 worth of these instruments is in use on the unit. A large instrument board affords the operators a constant picture of conditions within the plant. Speaking of operators, the Magnolia refinery selected from its employees a number of men regarded as highly qualified and gave them an intensive schooling in the operation of the Duo-Sol unit for about six weeks. By the time the process was ready for operation the men had received a thorough background in its management. This is one of the reasons given for the fact that since the plant started operations several months ago it has never had to shut down because of ignorant or negligent action on the part of the operators.

Corrosion of equipment is so slight that it does not constitute a problem of maintenance and operation. The Selecto is transported and stored in containers of ordinary steel.

Risks of fire from the use of propane are reduced to a minimum: first, by the general use of welded joints at points where this material is encountered; second, by the use of high factors of safety in the design of equipment containing propane under pressure; and third, by removal of open flames from the vicinity of equipment containing this flammable hydrocarbon. Much safety equipment is distributed about the unit.

Propane used by the Magnolia refinery is produced in the stabilization of gasoline from East Texas crude oil. The refinery obtains its Selecto from the Barrett Co., New York.

T.V.A. Announces Budget for Chemical-Engineering Program

AN EDITORIAL STAFF ANALYSIS

RECENT budget proposals for the Tennessee Valley Authority throw a rosy glow over the chemical-engineering aspects of the project and officially reveal for the first time the full magnitude of its plans. Unless the challenge to T.V.A. on the ground of constitutionality, being tested at this time in Alabama courts, should upset these plans, there is clear evidence of enlarging the vigorous chemical-engineering program already under way.

The proposed fertilizer program contemplates total expenditures during three fiscal years ending June, 1936, of approximately \$7,650,000. Over \$4,000,000 of this gross expenditure is for the remodeling and operation of electric furnaces to be used in manufacture of phosphoric acid. Two such furnaces are already operating and two more are to be converted under this program. A little more than \$1,000,000 is allotted to the construction of the blast-furnace phosphoric-acid unit with a small allotment of \$200,000 for operation during the fiscal year beginning next July. The fertilizer plant proper in which commercial-scale demonstrations are to be made of manufacturing methods, including concentrated fertilizers, will require in the aggregate about \$600,000, supplemented by approximately \$300,000 more for phosphate land exploration, development, and rock preparation facilities. Thus it is evident that about 85 per cent of the total expenditure will go directly into these major manufacturing activities.

Research and development work are, however, not neglected. Chemical-engineering projects which last year required nearly \$100,000 have been more than doubled during the current fiscal year and are proposed on a basis of \$550,000 for next year. In addition a special allotment of \$100,000 for coal research and semi-works plants for coal processing is contemplated. Announcements of T.V.A. from time to time make it clear that no promising mineral manufacturing or development plan lies beyond the field of interest of the Authority. The necessity for a large research budget is, therefore, evident.

Initial manufacture of superphosphate in the first two electric furnaces began Thanksgiving week, below estimated capacity but without serious difficulty according to reliable reports from Muscle Shoals. As operating difficulties are ironed out, it is expected that each of these two units will produce at the rated capacity of 24 tons per day of P_2O_5 in the form of phosphoric acid. On completion of the remodeling of two additional furnaces, anticipated before July 1, the capacity of the electric units will be nearly 100 tons per day of P_2O_5.

Designs for the new type of blast furnace to make phosphoric acid are, it is reported, still under consideration. But beginning of construction is provided for in the budget for this Spring with prospective completion during the Summer and initial operation in the Fall. No official estimates of capacity of this new unit have been announced but it is generally expected to operate on the basis of approximately 100 tons per day of P_2O_5 equivalent in the form of phosphoric acid. Fertilizer-manufacturing facilities are arranged to use acid either from the electrical units or from the blast furnace, but are not of sufficient capacity to permit operation of both divisions simultaneously at full output.

The coal-processing investigations first announced by Dr. A. E. Morgan some weeks ago are intended to explore the possibility of producing smokeless household fuel in the Valley, as well as for investigation of coke supplies to be used by T.V.A. itself. Both for electric-furnace and blast-furnace production of phosphoric acid, a cheap, but uniform, quality of coke is essential.

Definite plans for the marketing of superphosphate or mixed fertilizer produced in these works have not been announced officially. It is believed, however, that a substantial part of the production will go into cooperative research programs. A variety of such projects has been proposed. Some of these would be under close control by skilled agronomists, state experiment stations, or others interested in the scientific large-scale trial of fertilizers. According to another plan, T.V.A. would try out on small farms throughout the Valley its best ideas regarding fertilizer application making these demonstration units a basis for promoting fertilizer-using methods among backward farmers. These two plans, both of which will probably be used to some extent, would not consume a large part of the total production. Hence there remains the question as to commercial marketing or other disposition of the output of the fertilizer works.

One proposal is that land reclamation and erosion control be the basis of large-scale fertilizer use in the Valley. This plan has the support of certain parts of the Department of Agriculture and may be undertaken. However, pressure continues for the selling of T.V.A. production to farm cooperatives at a very low price. This idea, more or less inherent in the original concept of T.V.A., is, of course, vigorously opposed by the fertilizer industry.

Ultimate decision of fertilizer-marketing policies will presumably be made by high Administration officials, largely influenced by Congressional wish. A decision on a political basis, rather than on economic or technical considerations, is not unlikely.

Budget Data for T.V.A. Chemical Engineering Program

	Estimated, fiscal year 1936	Estimated, fiscal year 1935	Actual, fiscal year 1934
General administration	\$20,000	\$18,338	\$17,044
Construction electric furnace, fertilizer plant	....	903,770	415,996
Construct blast furnace, fertilizer plant	400,000	700,000	......
Leasing, proving, and development of phosphate lands	20,000	50,000	4,487
Operation of electric fertilizer plant	1,940,000	970,000	13,634
Design and construct 2 additional electric furnaces	....	120,000	......
Design and construct commercial size demonstration units for producing superphosphate	500,000	60,000	......
Idle plant maintenance, nitrate plants	50,000	50,000	5,209
Chemical engineering	550,000	227,316	96,772
Field washing plant for phosphate rock	200,000	....	.....
Operation of blast furnace plant	200,000	....	.....
Coal research and semiworks plants	100,000	....	.....
Engineering and technical service in connection with fertilizer distribution	10,000	....	.....
Engineering and economic surveys on proposed chemical processes	20,000	....	.....
Total	\$4,010,000	\$3,099,424	\$553,142
Less revenues	1,340,000	570,000	.....
Net	\$2,670,000	\$2,529,424	\$553,142

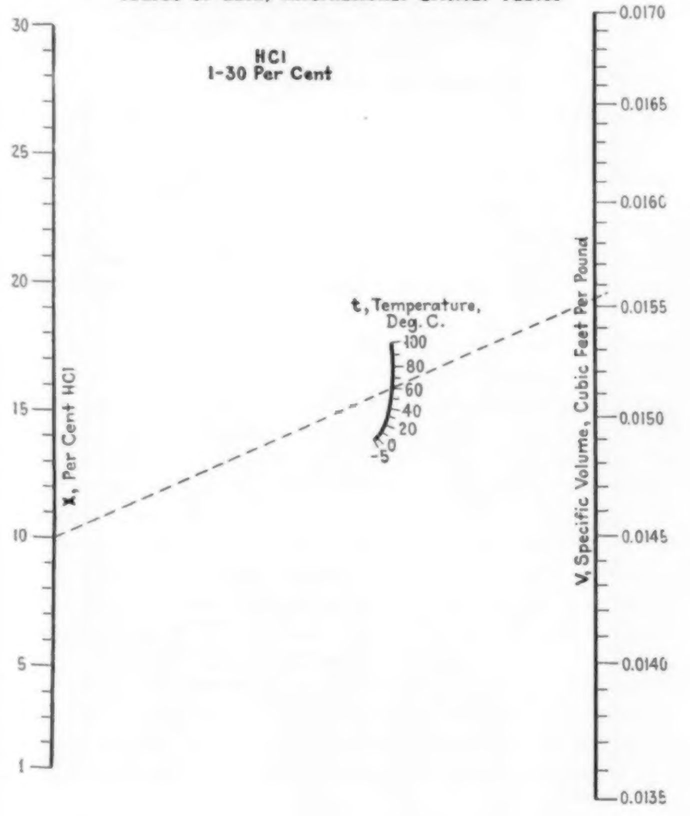
Charts for Specific Volumes Of Mineral Acids

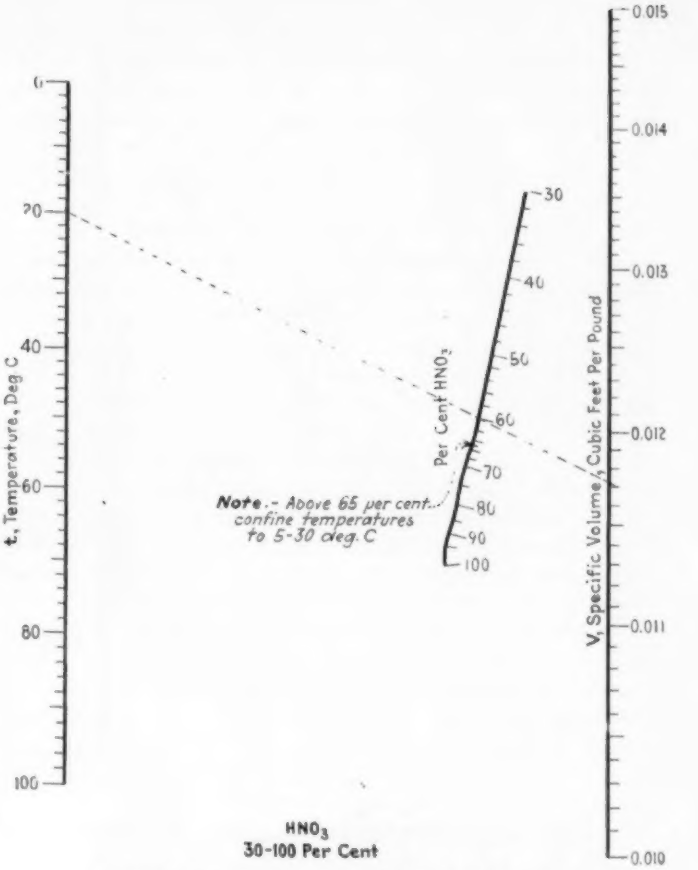
By J. H. PERRY and D. S. DAVIS
Respectively
Grasselli Chemical Co., Cleveland, Ohio, and
Dale S. Davis' Associates, Watertown, Mass.

IT IS FREQUENTLY necessary or desirable to know the specific volumes of the more common inorganic acids: sulphuric, nitric, and hydrochloric, as a function of both the temperature and the acid concentration, both for laboratory and for larger scale problems. The importance of having such data in an easily usable form is undoubtedly greater in the larger scale problems where extreme accuracy is of secondary importance to availability and moderate accuracy. In the shipment of such acids in a container, such as a drum, carboy, tank car, or the like, it is desirable from an economic standpoint to ship such containers filled as completely as possible or feasible. On account of considerations of safety, the danger of excessive expansion by temperature increase, and in order to conform to government regulations, it is necessary to ship less than the container will hold at the temperature obtaining during the filling operation.

To facilitate the determination of these specific volumes, therefore, the seven nomographic charts on this and the following page have been prepared.

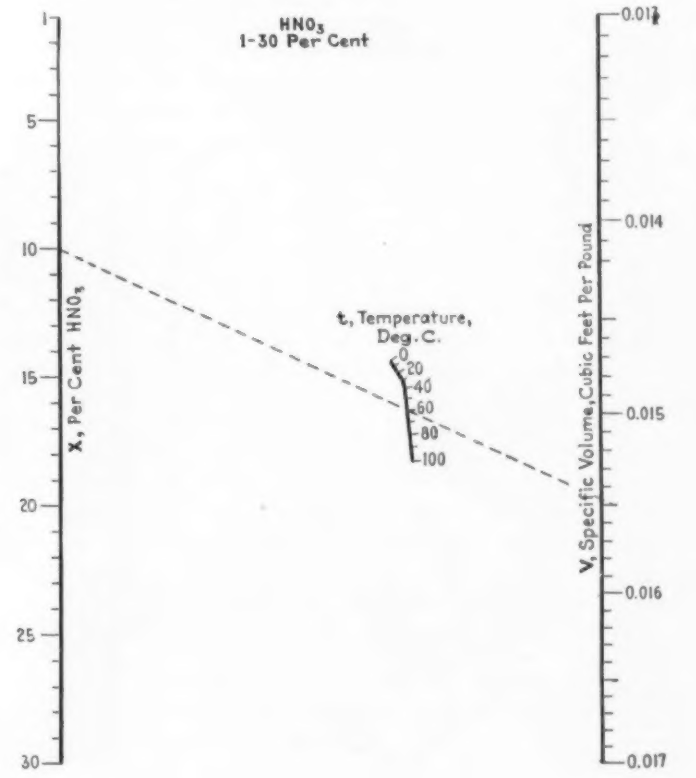
Specific volume of hydrochloric acid, 1-30 per cent, temperature range, —5-100 deg. C.; source of data, International Critical Tables

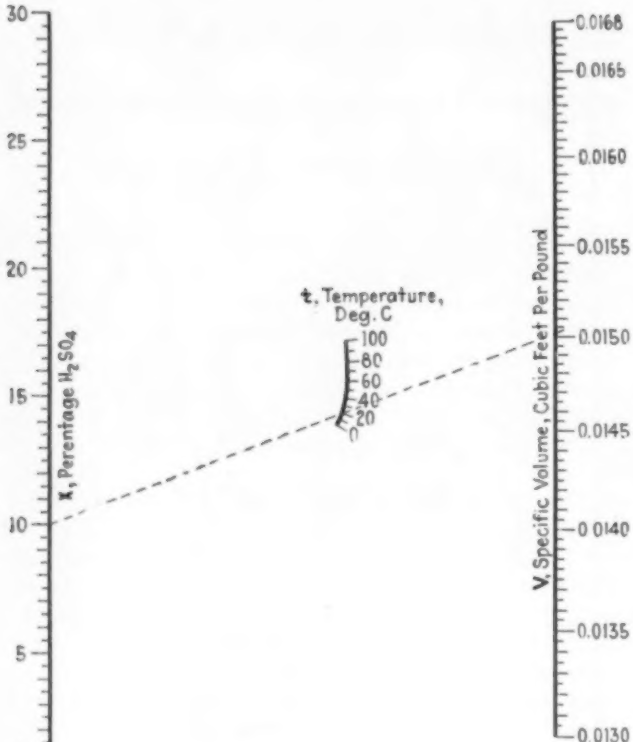




Specific volume of nitric acid, 30-100 per cent, temperature range, 0-100 deg. C.; source of data, International Critical Tables

Specific volume of nitric acid, 1-30 per cent, temperature range, 0-100 deg. C.; source of data, International Critical Tables



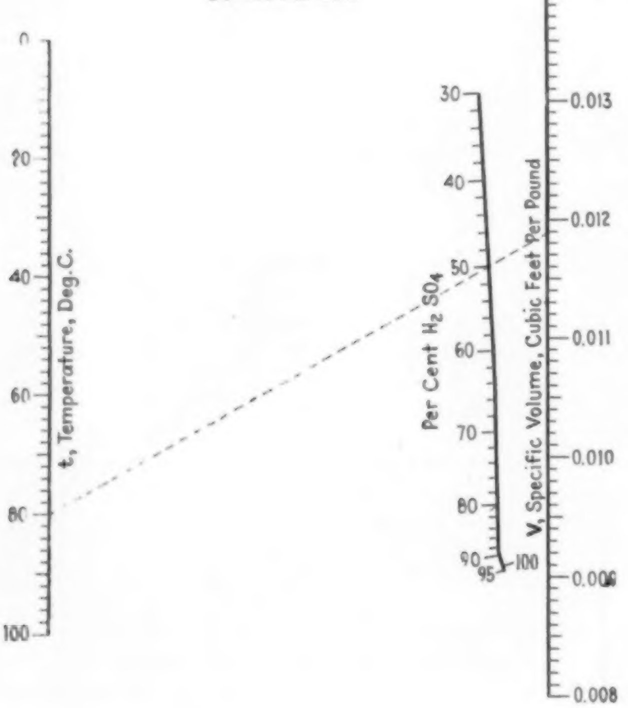


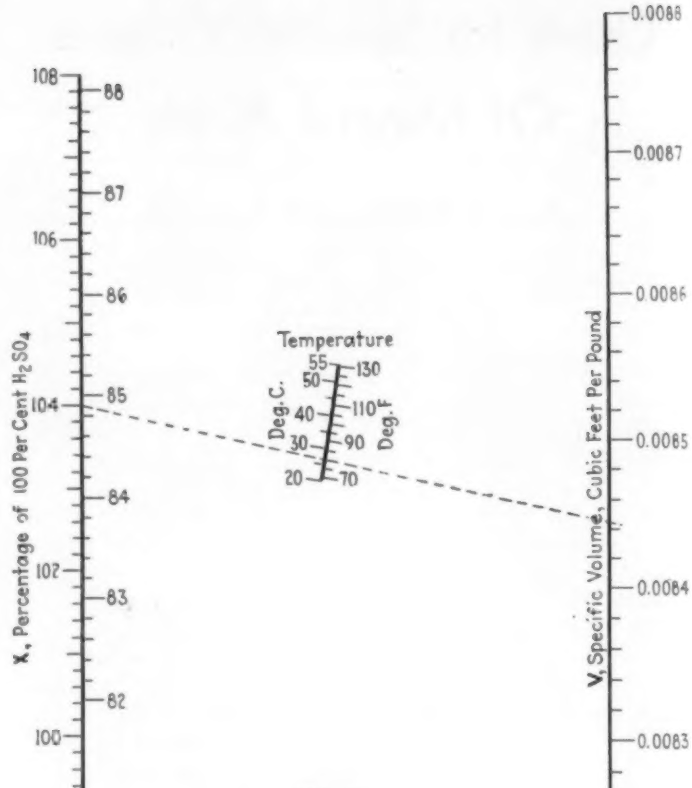
H_2SO_4
1-30 Per Cent

Specific volume of sulphuric acid, 1-30 per cent, temperature range, 0-100 deg. C.; source of data used, International Critical Tables

Specific volume of sulphuric acid, 30-100 per cent, temperature range, 0-100 deg. C.; source of data, International Critical Tables

H_2SO_4
30-100 Per Cent



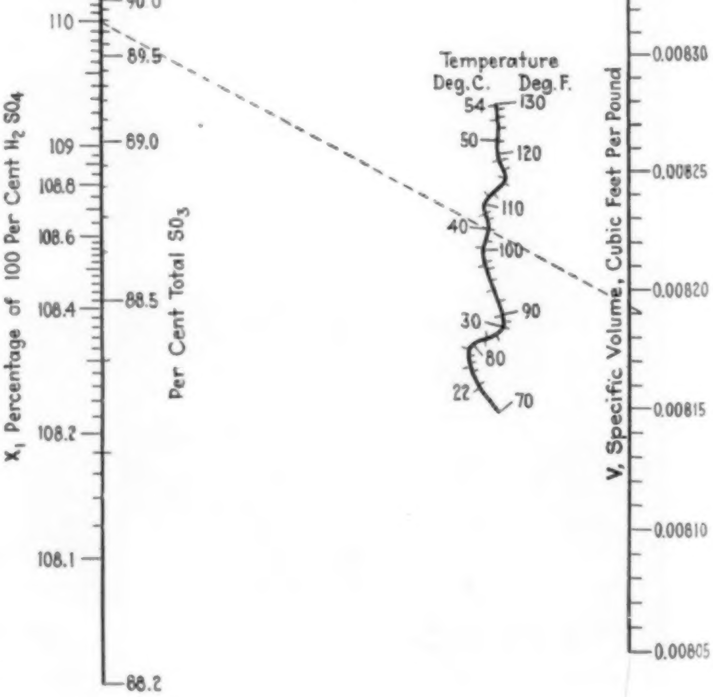


Oleum
99-108 Per Cent

Specific volume of fuming sulphuric acid, 99-108 per cent 100 per cent H_2SO_4, 20-55 deg. C.; source of data, Van Nostrand's Chemical Annual

Specific volume of fuming sulphuric acid, 108.1-111 per cent 100 per cent H_2SO_4, 22-54 deg. C.; source of data, Van Nostrand's Chemical Annual

Oleum
108.1-111 Per Cent



Retirement Pensions For Employees

By G. CHAUNCEY PARSONS
225 Broadway, New York

FACED as we are with the problem of social legislation which perhaps may make mandatory old age retirement pensions for the employees of all industry in the country, it may be well first to consider what has already been done in this respect within the chemical industry.

Among the many chemical companies which, according to the writer's knowledge and belief now have adopted retirement pension plans may be mentioned: E. I. Dupont de Nemours & Co., Atlas Powder Co., Hercules Powder Co., Murphy Varnish Co., Pratt & Lambert Co., Mennen Co., Procter & Gamble, Standard Oil companies, W. P. Fuller & Co., G. F. Harvey Co., Mallinckrodt Chemical Works, Eastman Kodak Co., American Smelting & Refining Co., Gilmore Oil Co.

These companies have adopted pension plans not from altruistic motives, but from a keen realization of the importance of providing for their superannuated employees. They recognized that unless adequate provision was made, the old employee was liable to become a burden on society or his relatives and friends. And I believe that they fully realized that in so instituting pension plans they were not only doing a good work for society at large, but actually providing a market, directly and indirectly, for their own products of manufacture. Furthermore, from a financial standpoint, they were doing it at a lower cost than it could be done in any other way.

The working out of the plans by these companies have proved eminently satisfactory in every way and from the cost angle have not caused any financial burden.

Surely the tried and proved example of these leading members of the industry makes one pause and consider that one would no longer be a pioneer in inaugurating an old age retirement pension plan which has been so admittedly proved by experience to be of outstanding merit.

The important points to be considered in the introduction and working out of a sound pension plan are the particular factors applicable to the individual company, such as age of employees, wage scales, average length of employment, and the question whether the cost is to be funded or unfunded, contributory or non-contributory.

As an example may be taken a man 30 years of age—let's call him Roger Bruce—who hopes and plans to retire at 65, when according to actuarial tables his natural expectation of life will be about 13½ years (a woman's expectation at 65 is almost 16 years).

Bruce, an average employee, is earning $1,500 to $2,000 a year and is presumably capable of carrying from $2,000 to $5,000 in life insurance, according to individual circumstances and conditions, and he is unquestionably looking forward to a long term of service with his present employer.

On a contributory plan, which fundamentally is a partnership agreement between the company and employee, the employer pays approximately one-half the premium and Bruce pays the other half.

Let us suppose that Bruce is looking forward to retirement at the age of 65 on a pension of $100 per month. Obviously there must be a reserve fund sufficient to take care of this. To accumulate this principal from the time Bruce is 30 until he reaches 65, deposits must be made monthly with compound interest.

The cost of this plan depends entirely on the average of the age groups and the amount of pension provided. Conservatively, this should run from three to six per cent of the payroll.

If credit is allowed for past service, that is, service prior to the installation of the pension plan, the cost of this service must be added. Sometimes this is paid for with a single premium and sometimes amortized over a period from 10 to 20 years. At the present time, then, it is often advantageous to pay this in a single premium as the discount rate allowed is quite favorable. The usual time of retirement for men is from 60 to 65; however, a lower age is usually used for the female employee. We cannot, however, make an absolutely correct calculation unless we know the interest rate at which the deposits are to be compounded.

Soundest, Cheapest, Most Efficient Plan

Setting up pension funds in this manner—known as the "funded plan"—is the soundest, cheapest and most efficient in the final analysis. When the insured funded plan is used with the necessarily adequate reserves, the pension, or annuity, is purchased while the employee is an active producer on the payroll and the pension cost becomes a charge against current and not future profit.

And a most important point, which would naturally give a sense of security to the worker, is that even in the case of the insolvency or merger of the corporation no effect would be felt in any way on that part of the pension already bought and paid for: the worker then is fully protected. In case of death his share, including interest, would be paid over to his beneficiary in cash.

In every case, before a pension plan becomes effective for the individual worker, there should be a probationary period varying from six months to two years, depending upon the nature of the employment, and before the retirement age the employee should have the privilege of selecting one of the regular annuity forms, other than the straight annuity, so that those dependent upon him, if any, should be amply protected.

In the event of strike, shut-down, or lay-off, provision should be made either for the suspension or continuation of the pension plan, dependent upon the nature of the individual company, until the worker is re-employed.

Each worker should be furnished with a certificate describing the plan, in as simple a language as possible. Furthermore, the plan should make provisions for future changes in conditions and should be capable of being modified although such modifications should under no circumstances be retroactive.

Large quantities of lime are required for softening the hot water used in melting the underground deposits before the sulphur is pumped to the surface

CHEMICAL LIME HYDRATE OF OPPORTUNITY

By SIDNEY P. ARMSBY
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Western Lime Works
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LIME IS one of the most widely used chemical reagents known to modern science. Yet comparatively little authentic information is available regarding its fundamental properties, a lack which seriously handicaps its efficient utilization and which clearly indicates the need of scientific research in this field.

Only too frequently the user of lime is lacking in knowledge of its chemical and physical properties; the non-technical consumer generally works by rule-of thumb methods. He thinks that all limes are essentially alike and that the value is determined by the price. Then, when something goes wrong, he usually follows the line of least resistance, declaring that he has been "gypped," or that "lime is no good anyway." And he is often correct in his first statement. He has been betrayed by his own cupidity. But the second is all wrong. The fact that he chose the wrong grade of lime for a particular purpose, or that he failed to use it properly, is analogous to the employment of a boy to perform the work of a grown man.

Unfortunately this tendency toward improper evaluation of lime is not limited to the layman or the non-technical consumer, but is shared by a surprisingly large number of theoretically competent chemists and engineers, many of whom fail to give due consideration to the factors affecting the functioning of the lime in their operations. True, they may try one brand after another till they finally secure the one that gives the best service per unit of cost. But when they have completed this trial-and-error experiment they still do not know why one lime is better than the rest. Nor have they any assurance that one of the less efficient limes might not become the best of the lot if some entirely permissible change were made in the operating technique.

A simple illustration is furnished by a plant where a large quantity of standard strength milk-of-lime was used. The engineers built an efficient lime-slaking unit, where one brand of quicklime after another was tested. One lime showing a higher available CaO content than the others was found very inefficient because so much "core" and "waste" were left in the slaking tanks. These had to be cleaned out every day or two, and it was impossible to deliver milk-of-lime of the desired strength. The lime was about to be condemned, when it was pointed out to the operating staff that what they had called "core" was not core at all, and that they had been discarding as "waste" a large percentage of partially slaked lime that had been "drowned" with too much water. An inherent property of this lime caused hydration to begin very slowly and with a minimum of wetting, while as the reaction progressed it was rapidly accelerated and required rather rapid addition of the remaining water. In trade parlance, the lime was easily "drowned" by the use of too much water during the first two minutes or so, and was just as easily "burned" by a subsequent lack of water. When the addition of water was properly regulated, it slaked perfectly and yielded more standard strength milk-of-lime per ton than any of the others tried.

Many similar illustrations might be given, but the point to be emphasized is that a thorough understanding of the utilization of lime is a pre-requisite for its proper evaluation. It is not enough to know that a certain hydrated lime contains 98 per cent total $Ca(OH)_2$, or that it shows 94 per cent "available lime" by a certain laboratory method. The wise consumer wants to know how much of it is "available" for a certain purpose and under a specific set of conditions, or within a definite period of time.

Many purchasing agents procure lime on the basis of specifications calling for a certain minimum of calcium oxide and prohibiting or penalizing more than certain maximum allowances of specific impurities. For some purposes this is satisfactory, but in a great many instances it is entirely inadequate. Of what value is a content of 97 per cent CaO if only half of it is available for reaction under a given set of conditions? Here the true rating would be nearer 30 per cent than 97 per cent, when allowing for the penalty for extra handling charges on the unavailable lime.

Recognition of the inadequacy of a rating scale based only on total CaO content has led to the wide-spread ac-

ceptance of specifications based on "available lime," and several convenient laboratory methods of determining this factor have been developed. Another frequently used method, generally termed the "rate of reaction" method, consists in determining the percentage converted to carbonate in a given length of time, and under controlled temperature conditions, by a standard solution of sodium carbonate.

Here four outstanding facts in regard to these laboratory methods present themselves:

1. There is seldom any consistent correlation between "reactivity" and "availability" as determined by these methods. This is clearly illustrated in Table I, a compilation of certain chemical and physical properties of standard brands of lime. Sample B shows 11.5 per cent less conversion by sodium carbonate than sample C, although in all other respects the two are almost identical. A similar difference between samples E and G, and many other apparent inconsistencies may be noted.

Table I—Chemical and Physical Properties of Commercial Hydrated Limes, Showing Lack of Correlation Between Various Properties.

Sample	Available Lime — Non-volatile Basis — %	Reactivity — (Amount converted by Na_2CO_3 in 1 Hr.) — %	Fineness — Through 250-Mesh Screen — %	Time Required to Settle to 50% Volume — Min.	Specific Gravity
A	93.5	....	100.0*	35.0	2.24
B	90.8	79.3	98.1	43.5	2.21
C	90.3	90.8	99.3	44.5	2.21
D	89.0	84.8	98.8	63.0	2.18
E	89.5	81.1	95.8	74.0	2.20
F	90.2	86.2	98.2	76.5	2.18
G	91.3	88.8	95.0	....	....

*100% through 325-mesh.

2. Solubility of lime in one medium is not a true index for other media, and rate of reaction with sodium carbonate does not measure the rate of reaction with all other compounds. The solubility of lime in water, or dilute hydrochloric acid is not the same as in raw sugar cane juice or sulphite cooking liquor.

3. No allowances are made for objectionable side reactions caused in actual service by impurities which are inert or neutral under the conditions of the test. A case in point is the experience of a large manufacturer of emulsified products who switched to a new brand of hydrated lime because it was found to give much better saponification. A difficulty soon arose, however, in the form of an apparent oxidation of the surface of the product in storage. The appearance of this surface layer indicated that oxygen from the air had effected a change in the composition of the emulsion, causing a lightening of the color and a decided loss of oiliness, together with a noticeably rancid odor. The phenomenon manifested itself within a few weeks after the material was made, and the thickness of the oxidized layer increased as time went on, till finally large stocks of finished goods had to be condemned. Careful chemical analysis showed that the lime which caused the trouble contained over 0.1 per cent of manganese, while the other lime contained at most only a few hundredths of a per cent of this element. As manganese abietate is known as one of the most efficient paint driers, it seemed logical to assume that the manganese in the lime had combined with certain of the resinous ingredients in the oils used for making the "sponge," or lime soap. The resulting compounds exerted a pronounced drying effect actually oxidizing the emulsion and seriously affecting its properties.

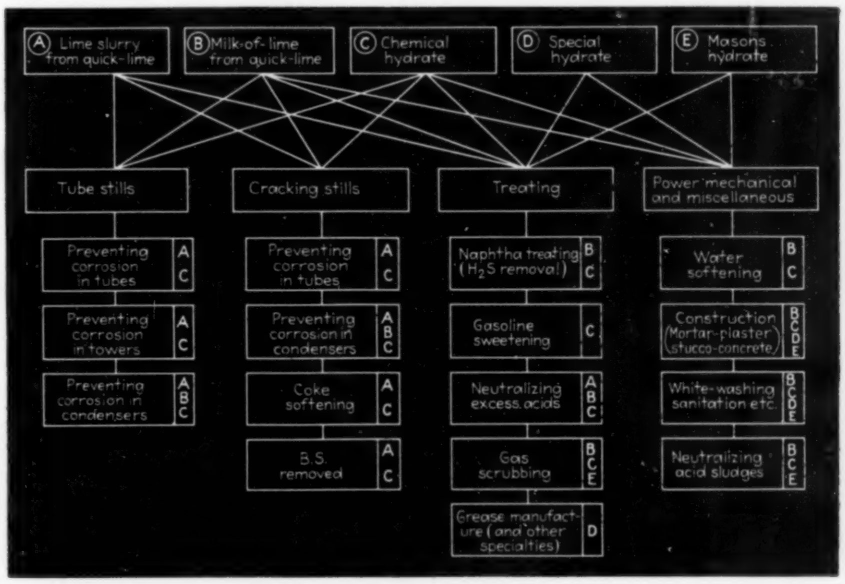
The "high-manganese" lime was more reactive in the saponification kettles than the "low-manganese" lime. Hence it produced a sufficient quantity of the "drier" to cause pronounced oxidation of the finished product, while the less active lime with its lower manganese content did not produce enough to have a noticeably bad effect. Therefore, the increased yields from the more highly reactive lime had to be sacrificed in favor of lower yields and better keeping qualities—simply on account of the detrimental effect of a small percentage of an impurity ordinarily considered of no practical importance.

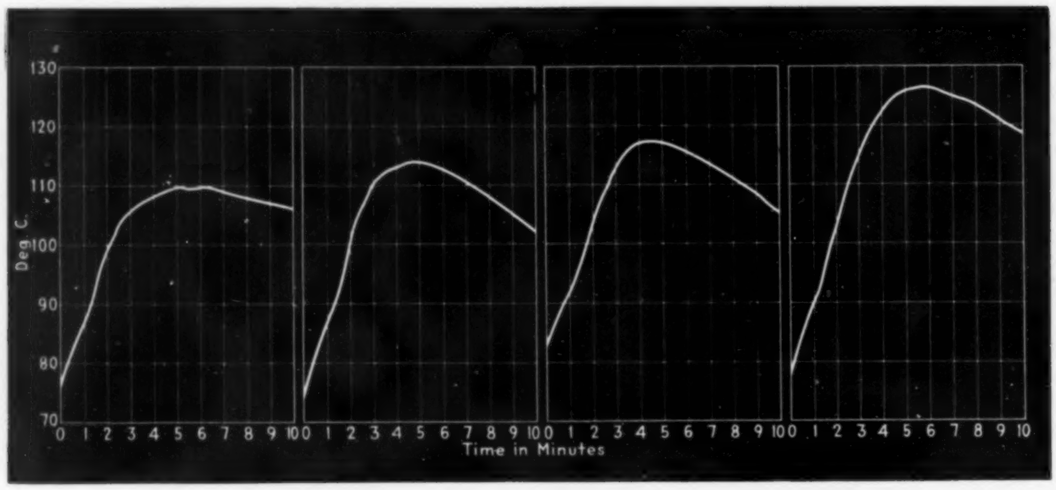
4. The influence of physical properties on chemical behavior is often much greater under service conditions than in a laboratory test. An illustration of this is cited by a varnish manufacturer who made kettle tests of two brands of hydrated lime to determine their relative efficiency under actual operating conditions. He found that 77 lb. of lime No. 1 produced the same result as 100 lb. of lime No. 2—a saving of 23 per cent—although the difference in "available lime" was only 8 per cent. The extra efficiency was due primarily to the greater fineness of lime No. 1—100 per cent through 325 mesh compared with 90 per cent through 200 mesh.

From the foregoing it is apparent that existing laboratory methods give correct results only for operating conditions which closely duplicate the conditions of the test. In other words, the laboratory test should be conducted to give proper weight to all the factors governing the action of the lime in actual use.

For lime used in water purification, the principal con-

Lime flow chart in a modern petroleum refinery





Time-temperature records of four successive batches of hydrated lime, made in the same hydrator and from the same quicklime, all with 70 per cent water. Each of these batches showed a different behavior in the subsequent milling treatment, thus indicating the possibility of regulating the milling characteristics by temperature control during hydration

sideration is its content of water-soluble CaO. With too high a content of MgO the value will decrease in proportion to the detrimental effect produced by this impurity. Similarly, if under operating conditions it settles out in less time than required for complete reaction, then it should be penalized by an amount equivalent to the CaO thus lost, unless it is possible to provide enough agitation to offset the settling. For lime used in rubber compounding, cream neutralization, varnish making, grease manufacture, coke softening, or other operations where both the degree of dispersion and the chemical composition are important factors, careful consideration must be given to both physical and chemical properties.

The first logical move toward correcting any faulty system is to find out its defects. After eliminating the disturbing factors, the next step should be one of replacement, by the adoption of more efficient practices. Final improvement of the system as a whole can only come through constructive criticism and concerted action. Only the combined efforts of producers and consumers will insure really worth-while results. To date such combination of effort has not been possible, largely because of the failure of both producers and consumers to fully appreciate their community of interest.

Existing conditions are challenging the lime industry to justify its claims for recognition as an efficient contributor to present-day industrial development. It has the facilities for setting up and maintaining a centralized and coordinated research and development organization commensurate with the importance of the problems involved. Such an organization, with a competent staff, and adequately supported by the entire industry, should become extremely valuable to both producers and consumers. Some of its indicated activities may be listed, briefly, as follows:

(1) Development of a better spirit of friendly cooperation between lime producers. (2) Establishment of full cooperation and free exchange of ideas between producers and consumers. (3) Assembly, classification and correlation of technical data on lime—now existing only in scattered and fragmentary form. (4) Laboratory and field studies, to fill the gaps in our present knowledge about lime and its properties. (5) Detailed study of processes in which lime is used; the chemical reactions involved; the physical conditions affecting these reactions, and the degree of effect introduced by each variable. (6) Interpretation of all such data, in the light of practical experience, so as to establish justifiable upper and lower limits of tolerance for various chemical and physical properties as well as workable methods for the measurement of these properties. (7) Publication of the findings, for the guidance of all interested parties, as well as for their constructive criticism.

Such a program, properly directed and consistently maintained, should result in a more efficient utilization of lime and a clearer understanding of the principles involved in its industrial applications. This must include the development and acceptance of simple, accurate specifications and laboratory technique. A properly functioning organization, working along the lines indicated above, should also sponsor many other important improvements, such as the development of new uses for lime, and the simplification of operating methods in many lime-consuming processes.

Cooperation of this kind can, and will be secured when the lime industry demonstrates its willingness and its ability to do its share toward promoting the best interests of its customers. Some of the probable future accomplishments of the technically minded lime manufacturer may be indicated by consideration of a few of the possibilities which have already been partially explored and developed by progressive companies and individuals:

Plasticity—It has been found that plasticity can be influenced by the use of catalysts during hydration, by proper selection of quicklime, and by the manipulation of such factors as the rate of addition of water; intensity

of agitation; duration of storage before use, and character of milling operations. Some manufacturers are now producing, from one grade of quicklime, two or more brands of hydrated lime, distinctly and uniformly different in plasticity, fineness, and particle structure. As more is learned about the real causes of plasticity it is reasonable to suppose that a product of any desired degree of plasticity can be made to order, by accurate regulation of temperature and rate of hydration; proper control of burning, hydrating, storage, and milling operations; correlation of particle size and crystal structure; or perhaps by the use of specific catalysts.

Settling Rate—This is known to be affected by size and structure of particles, total surface area, and other physical considerations. Fineness alone is not a guide to the settling rate of any lime, as is apparent in Table I. Neither is available lime content, rate of reaction, or specific gravity. Tendency of lime to settle out of suspension is perhaps governed by the same factors as is the plasticity. At least two manufacturers, working along this line, have produced hydrates with slower settling rates by making them more plastic.

Moisture Control.—It has been demonstrated that "raw," or freshly made, hydrated lime frequently contains both free moisture and free CaO (and presumably in close contact with each other). If such raw hydrate is allowed to remain for some time in storage the excess moisture combines with the free CaO, thus drying out the mass by the formation of $Ca(OH)_2$. Theoretically, it should be possible to regulate the quantity of water originally added so that, after proper aging, a perfectly hydrated product would be secured. It is doubtful, however, if any such perfect hydrated limes have ever been consistently produced. Nor is it at all certain that absolute perfection is necessary except in exceptional cases. Certain specific process operations have been found to be greatly facilitated by the use of a hydrated lime containing from 0.1 to 0.3 per cent free CaO, while much lower efficiency is obtained when even a small quantity of free moisture is present, or when the free CaO is in excess of 0.3 per cent.

Selective Milling Operations—It seems quite certain that the air separation methods employed in the manufacture of hydrated lime will be much improved and will play an important part in the development of highly specialized products. They will not only serve to isolate material finer than a given mesh size, but will also be used to differentiate between particles of different subsieve sizes, or to separate solid, crystalline particles from those of an amorphous structure. We know that hydrate made from a given quicklime two hours after burning often acts differently from the hydrate made from the same quicklime after it has been in storage for a few days. We also know that variations in hydrating temperatures affect the milling qualities of the hydrates; and that a highly plastic raw hydrate behaves very differently from one of low plasticity. As the effects and values of all these variables are classified, we shall probably see various types of air separation equipment used to produce, for example, one hydrate that is 100 per cent through 200 mesh and 95 per cent coarser than 500 mesh; another product all finer than 400 mesh; one fast settling; another slow settling; another from which a large proportion of certain impurities has been removed by gravity or centrifugal force, and perhaps several products with varying degrees of plasticity.

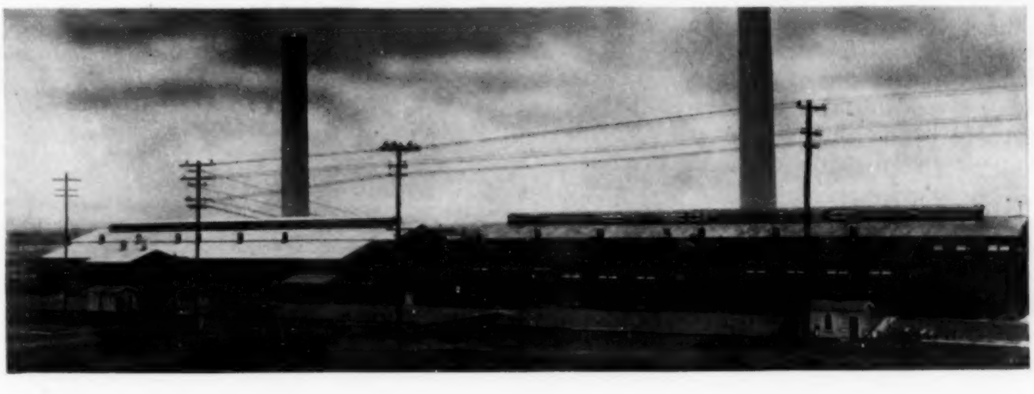
Scientific research, systematically conducted and consistently maintained, is urgently needed for the purpose of developing fundamental data that will supplement our present limited knowledge of the properties of lime, and lead to its proper evaluation and efficient use as a chemical reagent. A comprehensive research program can and should be instituted by the lime industry, in cooperation with various interested lime-consuming industries. Some of the probable benefits resulting from such a program will be:

1. Greater service to lime consumers, secured by the adaptation of special grades of lime to specific purposes; the availability of authentic information regarding the properties of lime; the correct evaluation of various factors affecting the efficiency of all lime products, and the adoption of simple and accurate laboratory testing procedure.

2. Greater profits to lime producers, resulting from the creation of new markets, reduction of manufacturing costs, and the possibility of avoiding unprofitable production and sales activities in fields for which certain products are not suitable.

3. Elimination of the existing confusion and conflicting opinions regarding the utilization of lime, and its deserved recognition as a versatile and valuable industrial chemical reagent.

Large steam power plants depend on lime to protect the boilers by removing scale-forming constituents from the feed water



Welding of Structures in the Chemical Industry

By C. O. SANDSTROM
*Thermal Engineering Co.
Los Angeles, Calif.*

Editor's Note—This is the last of a series of three articles in which Mr. Sandstrom has discussed the application of welding in the chemical industry. The first (July, 1934, issue of *Chem. & Met.*) dealt with weldability and weld types, while the second (September, 1934) discussed the welding of pipe and vessel joints.

EVOLUTION in the arts is frequently hampered by vestiges of former practices. Had the automotive industry been mind-free of the forerunner of the automobile—the buggy—the present form of automobile would have arrived many years ago. The history of mechanical development is replete with examples of devices performing after the fashion of their manual predecessors. The first pencil sharpener used knives that functioned like the hand and penknife. The modern successful pencil sharpener uses an entirely different principle. Steamships of the size and speed now common would not be possible with the old stern and side paddle-wheels. We seem to be "getting somewhere" in proportion to our willingness to cut loose from hampering tradition.

The art of fusion welding, when applied to structural steel, must accept the shapes and, to a considerable extent, the assemblages of the old riveting practice. But it won't be "getting anywhere" until designers cease using such details as shown in Fig. 1*a* and Fig. 2*a*. It is evident that the weld at the back of the vertical leg of the angle of Fig. 1*a* takes all the load when it is applied in the direction of the arrow. The other leg and its weld are then useless. A better connection is a simple plate with fillet welds, as shown at 1*b*, which is neater, stronger because of the effectiveness of both welds, and cheaper. Fig. 1*c* shows a similar attachment to a floor beam for the support of the ends of the joists.

In Figs. 1*d* and *e* are shown two methods of attaching connections to I-beams for bolting to girders or columns. At *d* the influence of tradition is evident. The angle clips, intended for riveting, are applied to the beam by welding the three edges of their contacting legs. At *e* a plate is welded across the end of the beam, there being only two beads of weld metal. The connection of *e* is more than capable of developing the strength of the connecting bolts or rivets, so the connection shown in *d* is somewhat wasteful.

Beams riveted or bolted to columns with the connection angles shown in Figs. 1*d* and *e* must be designed according to the bending moment formula $WL/8$, because such attachment cannot develop the strength of the beam. Welded to a column or other rigid support the beam approaches closely the fixity indicated by the moment formula, $WL/12$. A rigid fastening, however, does not produce the restraint called for by that formula unless the support is unyielding. I once saw a design in which a beam was welded to a flat side of a steel tank. The beam had been designed for complete restraint, or according to the moment formula, $WL/12$. In this case the maximum moment was in the span and its magnitude very nearly $WL/8$.

Welding beams to supports sufficiently rigid to produce restraint results in a great saving of material—a thing quite impossible with riveted connections, because of the comparatively large amount of metal removed from the flange section for rivet holes.

Occasionally there is seen a bracket made up of a gusset plate and two pairs of angles, as shown in Fig. 2*a*. In this design there is a great excess of weld metal joining the angles to the plate and to the column. Only a

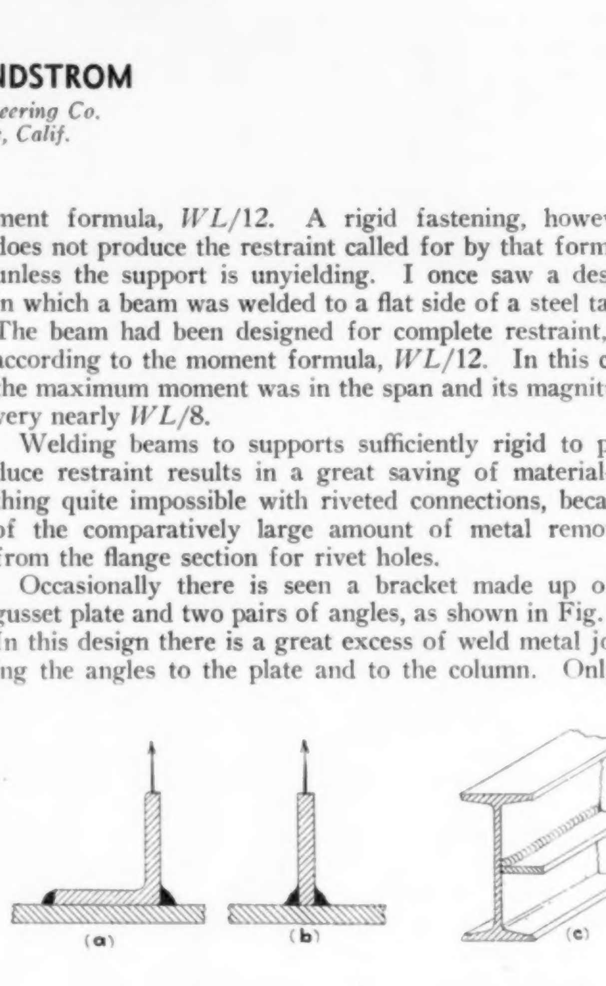
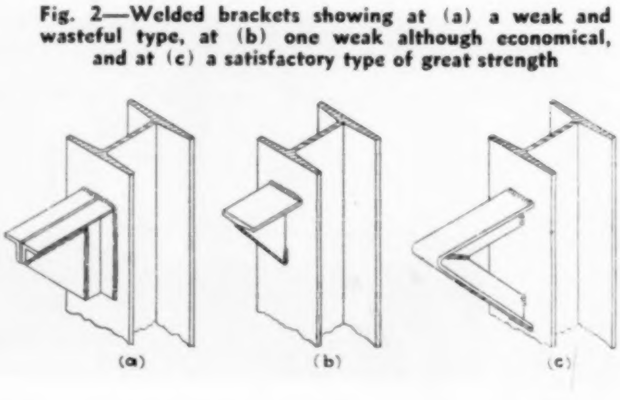


Fig. 1—Weld details for structures; (a) and (b) portray wrong and correct methods; (d) and (e) a wasteful and a suitable joint

Fig. 2—Welded brackets showing at (a) a weak and wasteful type, at (b) one weak although economical, and at (c) a satisfactory type of great strength



small fraction of the strength of this metal can be developed, because the limiting factor is the edge of the gusset plate, which carries a compressive load and which would buckle under a comparatively light load. A cheaper bracket is made from a piece of I-beam by cutting it diagonally through the web and welding to the column, as shown in Fig. *2b*. There is the same objection to this bracket as to the one of Fig. *2a*—the edge of the web is poorly adapted to resisting compression. A better design is shown in Fig. *2c*, which can be made from a tee or an angle. In this case the inclined member is capable of carrying a great load.

It is a curious fact that when welded work first replaces riveted work a great excess of weld metal is generally applied. This is due to the lack of confidence naturally attending the adoption of new processes. That this diffidence goes to ridiculous extremes is manifested by work frequently observed in which the apparent aim has been to apply as much weld metal as possible. Such work checked by means of the table of weld-rivet equivalents (see author's earlier article, July, 1934, p. 364) makes apparent the excessive weld metal; furthermore, it explains why some comparisons of costs of welded and riveted work detract from the former.

It is a common experience for manufacturers to have a customer accept as satisfactory welded joints in pressure vessels carrying flammable fluids under several hundred pounds pressure—who nevertheless insists on the supporting structure being riveted. The implication is that he deems the structure more important than the vessel.

Columns and Struts

The present forms of columns were devised for convenience in riveting shelves and lugs for the support of beams. In the I or H sections, whether rolled or formed of plate and angles, the radius of gyration about one axis may be several times that about the other. This form of cross-section is advantageous when the load is eccentric about the principal axis, but otherwise is a waste of material, since the least radius of gyration determines the allowable load on the column. Columns of circular cross-section have a constant radius of gyration and so have the ideal form for concentric loading; but until the advent of fusion welding the difficulty of attaching adequate beam connections precluded their general use. With the application of welding to building construction, however, will come cheap tubular members for use as columns, the immediate effect of which will be economy of material and some saving of space.

A 12-in. Bethlehem H-column, weighing 40.5 lb. per foot, has a radius of gyration of 4.93 on its primary axis, and 1.9 on its secondary axis. The area of the section is 11.9 sq.in. Based on the least radius of gyration and a length of 144 in., the allowable axial safe load by a common straight-line formula is $11.9\ (16{,}000 - 70 \times 144/1.90) = 127{,}000$. A 10-in. pipe, weighing 40.48 lb. per foot, has a radius of gyration of 3.67. Its allowable axial safe load is $11.9\ (16{,}000 - 70 \times 144/3.67) = 157{,}500$ lb., or 24 per cent more than the H-column. The longer the column the greater the effect of the increase of the radius of gyration; for a length of 20 ft., for example, the 10-in. pipe will have nearly 70 per cent greater capacity than the 12-in. H-column.

Trusses, Towers and Frames

Fusion welding is especially adapted to the construction of roof-trusses, towers and frames. In Fig. 3 are four kinds of joint for a pyramidal frame or tower. At *a* and *b* are detachable joints and at *c* and *d*, permanent ones. At *a* a short "gudgeon" of pipe is welded to the leg of the tower and the strut slipped over it with the brace rods serving for bolts. At *b* a lug is welded to the leg of the tower to provide for bolting, the braces again serving as bolts.

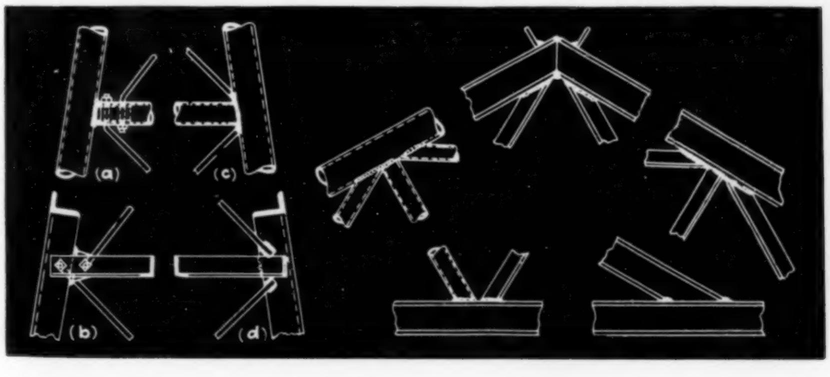
In Fig. 4 are shown some welded roof-truss details. The chords are I, H, or pipe sections, and the web members I's, H's, angles, tees or pipes. It should be noted that these members can be welded at their ends so as to develop their full strength—a thing quite impossible with riveted members.

In the design of angle struts and tension members, using two angles backed up to form a T and joined by rivets engaging a single leg, it is generally assumed that the stress is distributed uniformly over the net section. This is only a convenient fiction, however, as there is a large eccentricity and the extreme fiber stress may be several times the design stress. As the load is transmitted along the line of rivets it is obvious that besides the direct compressive stress, the eccentricity produces bending moment. Were it not for the friction between the ends of the angles and the gusset plates, produced by the pressure of the rivets in cooling, many such angle members might show signs of distress. The friction distributes the load more uniformly over the section and thereby reduces the stresses that are caused by eccentricity.

Welding the ends of the members of a frame, as shown in Fig. 4, prevents the eccentricity just discussed. Besides, there is no deduction for rivet holes. Furthermore, the ideal form —tubing—can be used, resulting in stress magnitude and distribution approaching theory and, in addition, presenting a good appearance.

Fig. 3. Left—Four welded joints for pyramidal towers, two detachable and two permanent

Fig. 4. Right—Welded roof-truss details showing use of I's, H's, tees, angles and pipes



M.C.A. Recommends Standard Carboy

WORK on the development of the new standard Manufacturing Chemists' Association carboy was initiated by the Carboy Committee in 1931, final tests being completed in November 1934. The Executive Committee of the Association then approved the new 13-gal. carboy to be known as the M.C.A. Standard Carboy, and recommended its adoption by the members of the chemical industry, to the exclusion of all of the present types, as new purchases are made.

Among the advantages involved in the adoption and use of the new standard carboy are:

1. Longer life—The availability of a new carboy of superior quality and greater durability as compared with any carboys heretofore in use, thus not only increasing the life of the container but in addition reducing the container cost for products shipped therein and the amount of breakage and hazard.

2. Economy of production—The adoption of a standard carboy will result in the elimination of waste in production of three different and distinct types of design. The amount of culls resulting from the new standard carboy will be minimized due to the new design being better adapted to the exacting requirements of the carboy manufacturer. Greater skill is acquired by the operators in the manufacture of a single type. The elimination of the narrow mouth—1½ in. x 1¾ in.—carboy will reduce waste to manufacture and also shorten the time from the blowing of the carboy to the introduction into the annealing oven.

3. Interchangeability—A standard carboy in the chemical industry will make all carboys interchangeable. It will eliminate the accumulation of different sizes at the chemical plants and the trouble and difficulty of returning these to the original owner for credit.

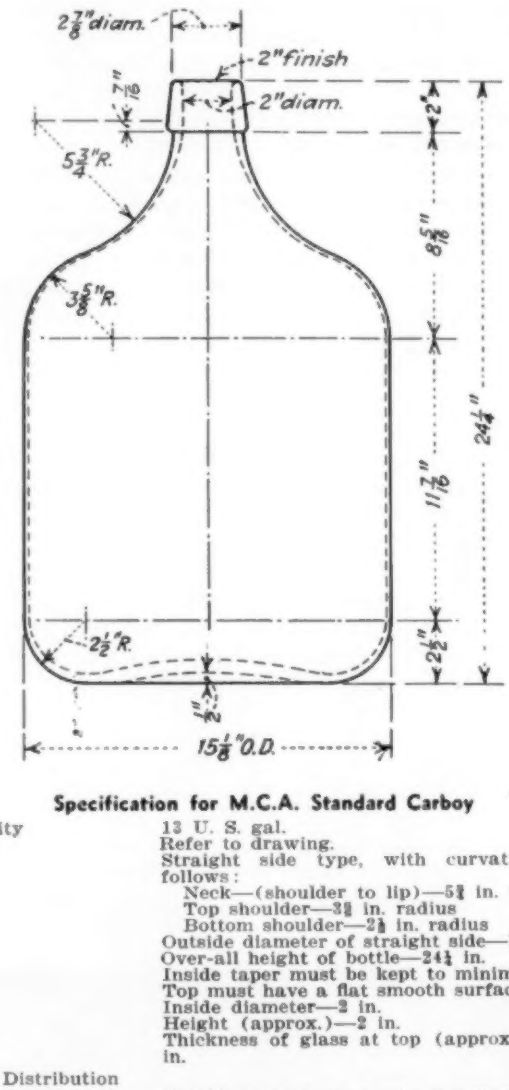
4. Ease of handling—A standard carboy also has advantages for both rail and truck transportation not possessed by the three present types which vary substantially in dimensions. It is confidently believed that breakage losses will decrease and consequently damage and breakage claims against the carriers will likewise decline which may result in a more favorable rating in freight tariff.

The data accumulated under the investigation served as a guide for the design of the model carboy. This work was completed only after painstaking and thorough consideration had been given to the requirements of the trade, —the need for maximum durability and feasibility of manufacture.

In the development of this design members of the Carboy Committee conferred with technicians and executives of the Gaynor Glass Works and other sources of information in order to insure full consideration of the kind and quantity of glass, the thickness and distribution of glass, the contour of the bottle, the design of a neck and lip which would permit a reduction to a minimum of the time elapsing between the blowing of the bottle and its introduction into the annealing oven or lehr. These factors were of critical importance in the design and production of a carboy of increased strength and durability.

A program was prepared to compare the proposed standard model with each of the three existing bottles, General, Grasselli, and Merrimac. The program included a drop test and impact tests on the bottom side, mid-side, shoulder, and bottom. The comparative superiority of the proposed standard over the three present types ranged from 32 to 51 per cent.

In order to compare the proposed 13 gal. standard with the three existing types of carboy packed in the different containers, a series of tests were conducted using the Interstate Commerce Commission side swing and bottom tests. The types of packing used included: (1) rubber block type, (2) composition cork and asphalt blocks, (3) improved Smith type, (4) cork blocks with elastic strip support, and (5) cork blocks with solid strip support. The swing tests were conducted at 65, 70, and 75 in., the I.C.C. minimum requirement being 55 in. A summary of the swing tests showed that the M.C.A. Standard Carboy rated over 30 per cent higher than the three present types.



Specification for M.C.A. Standard Carboy

Capacity	13 U. S. gal.
Shape	Refer to drawing. Straight side type, with curvatures as follows: Neck—(shoulder to lip)—5¾ in. radius Top shoulder—3⅝ in. radius Bottom shoulder—2½ in. radius Outside diameter of straight side—15⅛ in. Over-all height of bottle—24¼ in.
Lip	Inside taper must be kept to minimum. Top must have a flat smooth surface. Inside diameter—2 in. Height (approx.)—2 in. Thickness of glass at top (approx.)—7/16 in.
Glass Distribution	
Bottom	Should be kept as evenly distributed as is practical. One-half inch is considered a satisfactory average thickness.
Sides	Minimum thickness at the thinnest point 1/16 in.
Weight	Minimum—23 lb.
Annealing	Interval between blowing of bottle and delivery to the oven or lehr should be as short as possible. Bottle must be thoroughly annealed.
Marks	Additional to the required embossed marks on the bottom of bottle shall be the following "M.C.A. Std."

Air-Conditioning Features C.G.M.A. Meeting

EDITORIAL STAFF REPORT

THE twenty-second annual meeting of the Compressed Gas Manufacturers' Association convened in New York, January 21. The committee, in trying to arrange a program for this meeting, decided to make it a symposium on air conditioning, thinking that this subject would be of interest not only to those engaged in the manufacture and use of compressed gases, but also to those manufacturing equipment.

Lyle C. Harvey, vice-president of the Bryant Heater Co., opened the meeting with a general discussion of the future possibilities of air conditioning and was followed by W. H. Carrier of the Carrier Engineering Corp., who spoke on the present and future status of air conditioning. There are several angles from which we can consider air conditioning: First, the scientific—the physics of air conditioning and its physical effect upon products which are treated by this method. Second, there is the physiological aspect of air conditioning, the physiological need of certain atmospheric conditions— the physiological effects of various air conditions; third, there is the commercial and economic aspect of air conditioning. It is this last phase that was chiefly covered by the speaker.

Industrial air conditioning divides itself into two distinct classes. Industries manufacturing products such as textiles and tobacco, which require high humidities with only moderately controlled temperatures, may be considered to represent the first group. The second group includes applications in which lower humidities at lower temperatures are required, with some positive control of temperature conditions. This group is represented by the manufacture and storage of confectionery, gelatine products, and in certain processes the manufacture of cigars and cigarettes. To this group we should, of course, add, in this climate, air conditioning for human comfort and efficiency. R. J. Thompson, H. D. Edwards, H. E. Thomas, M. C. Queen participated in the discussion.

Container Research

G. O. Carter occupied the chair at the afternoon session on containers. Dr. Franz Eder of Robert W. Hunt Co. spoke on problems new and old in container research. Many of these problems have been discussed for quite a number of years, and some of them have been solved. Others are constantly arising and have to be solved or given up. The first of the problems mentioned by the speaker was fiber stresses. He found that many engineers and code authorities are using different formulas for the evaluation of such stresses in containers. That, to his mind, has been an unfortunate condition, although it seems justified by the attitude which the industry takes and by the problems which have to be faced. But the fact remains that the industry has variable yardsticks for the formula for fiber stresses in containers, reminding one somewhat of the problem of the fellow who bought a bushel of apples in Oregon and one in New York—the bushel measure was not exactly the same. Dr. Eder then offered another way of checking the formula and explained his method in detail.

He brought out the fact that the Association has been considering some spherical containers, and a good deal of work has been done by interested parties, and an agreement is going to be reached very soon. Dr. Eder stated that he favored this development because it has possibilities—that the ten per cent expansion limit in the spherical container means the same as a ten per cent expansion limit in a cylinder, provided that we are talking about fairly uniform walls and homogeneous materials. There is one thing that we always have to keep in mind for any container—that if an expansion is due to a very small local weakness or thinness in a wall, then it means something entirely different from an expansion which is blowing up the cylinder all along.

High-Pressure Containers

Dr. Rupen Eksergian of the Budd organization spoke on some of the technical considerations in the design of high-pressure containers. With the trend toward increased pressure in high-pressure containers, special consideration must be given to adequate factors of safety and to specification of materials used in their construction. The statement of a factor of safety is dependent on the strength theory used and the nature of stress concentrations in any particular design. In most cylinders severe stress concentrations occur at openings, with augmentation of stress as much as three times the normal tension. By proper reinforcement such stresses can be materially reduced. Other types of stress concentration are longitudinal bending stresses localized near the heads. Occasionally we must consider temperature stresses due to service temperature gradients as well as the decreased strength of material due to the high mean temperatures. Sometimes manufacturing conditions may result in eccentric inside walls relative to outside walls so that consideration must be given to possible augmented stresses due to eccentricity.

On the material side, the specifications must be consistent with possible fatigue due to undulating pressures, as well as with sufficient physical properties for high pressures. In general ample ductility is a very important element, particularly when considering stress concentrations and fatigue in large massive forgings. It is known that with mild steels the effect of stress concentration is greatly reduced. In considering materials, in addition to ordinary dimensional stress concentrations, we have intermolecular stress concentrations. Both would be expected to be reduced by ductility due to local plastic flow. With the more brittle materials the effect of stress concentrations becomes more emphatic.

If we regard the endurance limit governed by molecular stress concentration, the relative ductility, and the yield point rather than the ultimate strength, it would be necessary to explain the effect of these factors in maintaining with a simple fatigue specimen the apparent constant percentage on the ultimate strength with ordinary carbon steels. Raising the carbon content raises the tensile strength, increases the ratio of yield to ultimate and reduces the ductility.

Chemical Engineer's BOOKSHELF

Organic Chemical Engineering

Unit Processes in Organic Synthesis. *P. H. Groggins*, Editor-in-Chief. Published by McGraw-Hill Book Co., Inc., New York. 689 pages. Price, $5.50.

Reviewed by *Harold W. Elley*

AS POINTED OUT in the introduction by Mr. Groggins, this new textbook in the Chemical Engineering Series is primarily intended for advanced students in chemistry and chemical engineering and from the standpoint of the student it should be of great interest and real helpfulness. It should be the student's primary aim to equip himself with the general tools whereby he can pursue either the teaching or practice of chemistry and in this book many of the fundamentally important reactions (tools) are presented by means of appropriate data. The student should not expect, as a result of studying this book, to have obtained the last word concerning the technical side of organic chemistry. He will nevertheless have an excellent background for the special problems he will meet if he engages in industrial work.

From the standpoint of the man in industry it is interesting to have this grouping of various operations under logical categories depending on like reactions although the actual helpfulness may not be of particular importance. It is doubtful whether chemists and engineers in large concerns having an extensive background of development will increase their knowledge greatly by reading the book since the processes described are quite generally known and the company files are more advanced and contain a mass of important detail that could hardly be included in a book such as the one under discussion. For people in smaller concerns or for the independent commercial chemist, the book may prove quite invaluable.

Perhaps the book could have been shortened with advantage since in many cases there is a duplicate presentation of subject matter as illustrated on pages 151 and 194. In a few places the language is poorly constructed with consequent lack of lucidity. Some of the definitions are functional and certain technical names and terms are not defined. On the other hand, the good points far outweigh any adverse criticism and it is believed that the book will serve a very useful purpose in bringing together in a logical manner, information on the important unit reactions of organic chemistry. It is a splendid piece of work and a welcome addition to chemical literature.

Chemical Patents

The Law of Patents for Chemists. By *Joseph Rossman*. Published by Williams and Wilkins Co., Baltimore, Md. Second edition. 378 pages. Price, $4.50.

Reviewed by *Arthur L. Davis*

THE TEXT of the first edition has been enlarged in several places with new decisions and references included to bring it up to date. A new chapter on special chemical patent problems relating to bacteriology, food, medicine and metallurgy points out the more perplexing problems in these fields and presents some excellent suggestions relative to their solution.

An enlarged section on employer-employee relations presents this important subject clearly and defines the status of ownership of inventions depending upon relations under definite contract and relations without specific contract. This section shows that in general, under express or implied contract to assign, the ownership of inventions accrues to the employer regardless of the relation of consideration to duties of employee or any subsequent change in this relation, while without an express or implied contract to assign, the ownership of inventions is more equitably determined by established principles of patent law based on the nature of the invention and its relation to the duties of the employee.

A new section on the appraisal of a chemical invention points out impressively the necessity for complete economic, patent, statistical, scientific and technical information relating to the subject of the invention and shows the necessity for competent and expert evidence in this connection.

Technical Gas Analysis. By *George Lunge*. Revised and rewritten by H. R. Ambler. D. Van Nostrand Co., New York. 410 pages. Price, $8.

SO MANY IMPORTANT advances have been made in the technique of gas analysis during the twenty years which have elapsed since the appearance of the first edition of this book that a complete rewriting has been necessary. Many new instruments and methods have been included, while several of the older descriptions have been shortened or taken out entirely. As far as possible the subject matter has been arranged in the same order as in the former editions. On account of the growth of physical methods of gas analysis these have been grouped together in a separate section; a special section has also been devoted to the analysis of flue gases.

Industrial Furnaces, Vol. I, Third Edition. By *W. Trinks*. John Wiley & Sons, New York 456 pages. Price, $6.

VOL. I DEALS mainly with the principles underlying design and operation of industrial furnaces. Much new data made available through research since the appearance of the first edition, twelve years ago, have been added. To facilitate furnace calculation a large number of graphs has been included, showing the relation between the many variables, and many numerical examples have been given to illustrate every principle and method of calculation. The volume should be of great value to all engaged in the design, construction, or operation of industrial furnaces.

Marketing Machinery

Marketing Industrial Equipment. By *Bernard Lester*. Published by McGraw-Hill Book Co., New York. 307 pages. Price, $3.50.

Reviewed by *James E. Moul*

MOST DECIDEDLY this book gives an "insight into the factors which guide the distribution of machinery and equipment by the seller and the factors which inspire the purchaser to buy." It clearly distinguishes them from the factors that are involved in the sale of most consumption goods, particularly staple items such as food, clothing and furnishings.

The author has approached his subject with a carefully recorded history of the evolution of capital-goods production and selling. He has used for his illustrations simple and easily understood charts. In addition to this, he has used what he calls "cases" for examples of well chosen everyday business situations covering both manufacturer and purchaser problems from every angle.

Various phases of distribution and product analysis are not only suggested but are explained clearly and logically. Unlike many attempts of this sort, this book is not just a collection of well known facts. It is a most careful analysis of the formation and method of attacking problems faced by all manufacturers and distributors of industrial equipment.

The author has also very skillfully given basic principles for the selection and organization of a sales force as well as some excellent ideas as to sales expense. The subject of sales promotion is given its place in the sun with some very pertinent comment.

It is made evident that the so-called high pressure salesman certainly has no place in this field and that if in it at all he is a decided liability. The author has brought to our notice, most pointedly, that successful sales engineering combines more requirements than most any other form of selling. It requires not only the study and knowledge of markets but a thorough knowledge of the product plus a knowledge of the prospect's problems and their intelligent analysis for proper and economic application.

This approach to the subject of competitive distribution of capital goods should prove a most valuable help to every executive in that field.

Literature of Colloids

INTRODUCTORY COLLOID CHEMISTRY. By *Harry N. Holmes.* Published by John Wiley & Sons, Inc., New York. 193 pages. Price, $2.50.

LABORATORY MANUAL OF COLLOID CHEMISTRY. By *Harry N. Holmes.* Third edition. Published by John Wiley & Sons, Inc., New York. 248 pages. Price, $3.25.

Reviewed by *Frederick E. Schmitt, Jr.*

OF THESE TWO BOOKS, the second is a third edition, revised and reset; while the first is a new book designed to accompany the laboratory manual and to give a short, clear, yet comprehensive picture of the fundamental theory of colloid chemistry. It was written not to be placed in competition with the standard works of reference on the subject such as Thomas, Alexander and Bancroft, but to offer a brief summary of the field for those who have relatively little time to devote to the subject, and for those who want a short reference work at hand as an index to a more extensive library. In this it does not succeed as well as, let us say, Conant's brief yet lucid introduction to "Organic Chemistry." It is, nevertheless, a good book, well planned, with a slight tendency to favor individual examples at the expense of a broad, clear picture.

The "Laboratory Manual," on the other hand, is almost as complete a text on theory as well. The method of experimental presentation is peculiarly adapted to the subject in hand. The novice will find the experiments set forth to illuminate the brief theoretical discussions a distinct and valuable aid to the visualization of abstruse conceptions such as adsorption and surface tension. Even to the seasoned chemist the careful descriptions of what to do and how should prove stimulating and thought-provoking.

COLLOID CHEMISTRY. By *Arthur W. Thomas.* Published by McGraw-Hill Book Co., New York. 512 pages. Price $4.

THIS IS A BOOK on modern colloid chemistry. The whole range of subject work up to the present year has been drawn upon and summarized in the light of present day technique and knowledge. Those points, both theoretical and practical, which have proved of value and will directly assist in building up the structure of the theoretical edifice have been given preference as to space and thoroughness over isolated data, a refreshing trend in this field. The result is a clear and comprehensive picture of the science of colloids as it appears today. At the same time, no significant negative evidence has been left out. Notable are the descriptions of the techniques involved in the various fields of investigation, which give a workability to the subject entirely apart from the carefully weighed and presented theoretical discussions.

THE PHYSICAL BASIS OF THINGS. By *John A. Eldridge.* Published by McGraw-Hill Book Co. 407 pages. Price, $3.75.

EVERYONE who has the desire to discover for himself the meaning behind the great strides of modern physics will want to read this book. It will not teach as much about physics in its modern dress as Richtmeyer; nor as much of the resounding impact on philosophy as Eddington or Jeans; it will only enable the reader to start on ground familiar to him and to learn what has happened and what these events may mean. The book is excellently arranged, with an appended questionnaire to aid in grasping the sense of the concepts set forth in each chapter. Best of all, it is written and set in a stimulating style, covering much needed ground between the lines.

Gas Standards

STANDARDS FOR GAS SERVICE. Published by National Bureau of Standards Circular No. 405. For sale by Superintendent of Documents, Washington, D. C. Price, 20 cents.

THIS IS far more than a set of recommendations on proper regulation of city utility enterprises. It is actually an interpretative handbook showing the relationship between manufacturing methods, quality of product, and cost of rendering service. In some respects it is the closest to a real analysis of gas-engineering economics that is to be found anywhere in print. Anyone interested either in gas production or utilization efficiency can profitably study it.

A STUDY OF CRYSTAL STRUCTURE AND ITS APPLICATIONS. By *Wheeler P. Davey.* McGraw-Hill Book Co., New York. 695 pages. Price, $7.50.

COLLEGE GRADUATES with a good knowledge of physics, chemistry, and metallurgy will find this volume a valuable aid in the study of the theory and technique of crystal analysis. The subject matter has been arranged under three main heads; preliminary information about diffraction and crystal structure; methods of crystal analysis; and applications in physics, chemistry, and metallurgy. The arrangement is such that these divisions may be taken up for study in the order that suits the need of the reader, and as far as possible each chapter may be studied with only an elementary knowledge of the preceding chapters.

PRINZIPIEN DER GALVANOTECHNIK. By *J. Billiter.* Julius Springer, Berlin. 326 pages. Price, 25.50 Rm.

AFTER A comprehensive treatment of the theoretical principles underlying electroplating the author discusses the deposition of the following metals: Copper, zinc, cadmium, iron, nickel, cobalt, chromium, silver, gold, lead, tin, the platinum metals, tungsten, arsenic, antimony and bismuth. Deposition of alloys has also been included. Other chapters deal with the treatment of the base metal prior to plating, examination and testing of deposits, and corrosion.

METALLOGRAPHIE DES ALUMINIUMS UND SEINER LEGIERUNGEN. By *V. Fuss.* Julius Springer, Berlin. 219 pages. Price, 21 Rm.

STRUCTURAL STUDY of aluminum and its alloys is becoming more and more important as industrial applications of these materials are increasing. From the available literature the author has selected the phase diagrams of all important binary and ternary aluminum alloys. These have been completed or redrawn according to the latest information in the field, and with the numerous literature listings they make the book a valuable reference volume. A condensed tabulated presentation of crystallization phenomena for the various compositions permits easy review of melting and solidification reactions and facilitates prediction of technical properties. Special chapters are devoted to heat-treatment, corrosion, effect of non-metallic impurities, welding, and physical testing.

THE STONE INDUSTRIES. By *Oliver Bowles.* McGraw-Hill Publishing Co., New York. 519 pages. Price, $5.

REMARKABLE progress has been made during the last decades in the quarrying and the marketing of stone. Next to agriculture it is the most widespread of all industries in the country.

Among the outstanding examples of the use of the products in the chemical industry are limestone manufactured into cement, lime, or calcium carbide; dolomite made into refractories; and the utilization of crushed sandstone in the manufacture of glass. Coal and oil burned in quarries, kilns, mills, and cement plants constitute an appreciable part of the fuel produced in this country, and the explosives used create an important outlet for the chemical industries. As no book adequately covering the stone industries has formerly been available, the publication of this volume is timely and should supply a definite need.

MINERAL RESOURCES OF THE UNITED STATES 1931. By *O. E. Kiessling*. Published by U. S. Dept. of Commerce, Washington, D. C. Part I, Metals; 710 pages. Price, $1.50. Part II, Non-metals; 675 pages. Price, $1.

THIS REPORT, the 49th of an annual series, is published in two parts. Part I contains a general summary of all mineral products, and also chapters containing general reports on various metals and metalliferous mineral products. Part II consists of 29 chapters, each relating to one, or a group, of the non-metallic mineral products, including the mineral fuels, coal, oil, and gas.

PRACTICAL EVERYDAY CHEMISTRY. By *H. Bennett*. The Chemical Publishing Co., New York. 305 pages. Price, $2.

A COMPILATION of empirical working formulae used in making a variety of products, such as drugs and cosmetics, polishes, soaps, and cleaners, lubricants, food products and beverages, photographic materials, and many others. The book contains only practical information and does not give anything on theoretical chemistry.

Chimie et Metallurgie

CHIMIE 1935. 54 Edition. By *Emile Javet*. 400 pages. Price, 24.40 Fr. METALLURGIE 1935. 51 Edition. By *R. Cazaud*. 426 pages. Price, 24.40 Fr. Published by Dunod, Paris.

TWO COMPILATIONS of useful data for chemical and metallurgical engineers. The chemical edition of the handbook presents, in tabulated form, the most important chemical and physical constants, formulas, composition, and properties of organic and inorganic compounds; data on analytical chemistry, pH determinations, and corrosion resistance have been included. In the metallurgical edition are found data on fuels, refractories, and furnaces, electrolytic processes, alloy technique, testing, pyrometry, corrosion resistant materials. Special chapters have been devoted to the more important metals.

Classification of Petroleum Literature

AT THE RECENT MEETING of Special Libraries Association a Petroleum Section was formed within their Science Technology Group. The intention of this section is: To bring in closer contact all librarians whose work deals with petroleum and its allied subjects; to make a Decimal Classification of Petroleum Subjects; to facilitate inter-library loans; to exchange duplicate material. Any librarian interested is requested to write Albert Althoff, Librarian, General Petroleum Corp. of California, Los Angeles, California.

A.S.T.M. STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS. 340 pages. Price, $1.75. THE SIGNIFICANCE OF TESTS OF PETROLEUM PRODUCTS. 76 pages. Price, $1. Two reports prepared by A.S.T.M. Committee D-2 on PETROLEUM PRODUCTS AND LUBRICANTS. Published by American Society for Testing Materials, Philadelphia, Pa.

A COMPILATION of all test methods, specifications, and definitions of terms relating to petroleum products and lubricants. It contains 53 test methods, six specifications, and two lists of standardized definitions of terms, one covering petroleum terms, the other materials for roads and pavements.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Report of National Resources Board. 452 pages; $4.50 (Cloth).

Report of the Mississippi Valley Committee of the Public Works Administration; $1.50.

Report of the Science Advisory Board, July 31, 1933 to September 1, 1934. Copies available from Science Advisory Board, 2101 Constitution Avenue, Washington, D. C.

Development of the Rivers of the United States. House Document 395, 73rd Congress, 2nd Session; 80 cents. Message from the President of the U. S. transmitting a preliminary report.

Manufacturing Developments in Argentina, by George Wythe. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin No. 820; 5 cents.

Cotton Production and Distribution, Season 1933-34. Bureau of the Census, Bulletin 171; 5 cents.

Studies on the Metabolism of Copper, by E. J. Coulson and others. Bureau of Fisheries Investigational Report No. 23; 5 cents.

Fertilizer Studies With Sugar Beets in the Arkansas Valley Area, Colorado, 1921-28, by L. A. Hurst. Department of Agriculture Circular 319; 5 cents.

Experiments With Nitrogen Fertilizers on Cotton Soils, by J. J. Skinner and others. Department of Agriculture Technical Bulletin 452; 5 cents.

The Tariff and Its History. U. S. Tariff Commission Miscellaneous Series; 10 cents. A collection of general information.

General Specifications for Inspection of Material. Issued by the Navy Department, September 1, 1934.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Acid, sulphuric, concentrated, for storage-battery electrolyte, 51A2d; Batteries, storage, lead-acid, radio "B," 17B9a; Titanium pigment, dry and paste 52T4b; Soap-powder, P-S-606.

The Brown Iron Ores of the Western Highland Rim, Tennessee, by Ernest F. Burchard. State of Tennessee, Department of Education, Division of Geology, Bulletin 39, 1934.

Oxides of Iron Suitable for Pigment Purposes. U. S. Tariff Commission Report No. 88, 2nd Series; 5 cents.

Arsenic, by Paul M. Tyler and Alice V. Petar. Bureau of Mines Economic Paper 17; 5 cents.

Isolation and Study of the Humic Acids From Peat, by Chester L. Arnold and others. Bureau of Mines, Report of Investigations 3258; mimeographed.

History of Wages in the United States From Colonial Times to 1928. Bureau of Labor Statistics Bulletin 604, a revision of Bulletin 499, with supplement for 1929-1933.

Union Scales of Wages and Hours of Labor, May 15, 1933. Bureau of Labor Statistics Bulletin 600; 15 cents.

Citations to Public Health Laws and Regulations, 1931. Public Health Service, Supplement No. 111 to the Public Health Reports; 5 cents.

Effect of Inhaled Marble Dust as Observed in Vermont Marble Finishers, by Waldemar C. Dreessen. Public Health Service, Reprint No. 1630; 5 cents.

Manual of Fire-Loss Prevention of the Federal Fire Council. Bureau of Standards Handbook No. 19; 20 cents.

The Explosion and Fire Hazards of Hydrocarbon-carbon Tetrachloride Mixtures, by G. W. Jones and R. E. Kennedy. Bureau of Mines, Information Circular 6805; mimeographed.

Preliminary Report on a Survey of Crude Petroleum Cost of Production for the Years 1931-1933 and Comparison With Years 1927-1930. Petroleum Administrative Board unnumbered document; 10 cents.

Mechanical Equipment Used in the Drilling and Production of Oil and Gas Wells in the Oklahoma City Field, by Gustav Wade. Bureau of Mines Technical Paper 561; 10 cents.

Losses of Gasoline in Storage and Handling. Bureau of Standards Letter Circular LC-427; mimeographed.

Waste of Natural Gas in the Texas Panhandle, 1933-34. Bureau of Mines M.M.S. 346; mimeographed. A preliminary statistical summary.

Natural-Gasoline Plants in the United States, January 1, 1934, by G. R. Hopkins and E. M. Seeley. Bureau of Mines Information Circular 6808; mimeographed.

Analyses of Crude Oils From Some Fields of Southern Louisiana, by A. J. Kraemer and E. L. Garton. Bureau of Mines Report of Investigations 3253; mimeographed.

Production of Explosives in the United States During the Calendar Year 1933, by W. W. Adams, and others. Bureau of Mines Report of Investigations 3257; mimeographed.

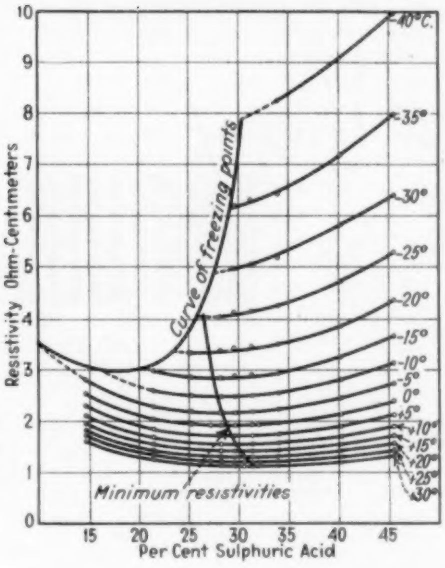
Census of Manufactures, 1933—Summary by Industries. Bureau of the Census; mimeographed. Shows general statistics only. Those wishing detailed statistics for any particular commodity should ask by name of commodity.

Mineral Production Statistics for 1934—advance preliminary mimeographed statements from Bureau of Mines on: Lead; copper; iron ore; manganese ore; zinc; copper, lead and zinc mining.

Your Plant NOTEBOOK

Resistivity of H_2SO_4

IN AN ARTICLE appearing in the November, 1934, issue of the Bureau of Standards *Journal of Research*, by G. W. Vinal and D. N. Craig, data obtained in a recent research on the resistivity of sulphuric acid solutions were presented. No data on resistivities below 0 deg. C. have previously been available. The new information, which is particularly valuable to chemical engineers concerned with storage batteries, are summarized in the accompanying graph in which curves of resistivity (reciprocal of conductivity) are plotted for strengths of acid ranging from 15 to 45 per cent.



News of EQUIPMENT

Centrifugal Compressor

Roots-Connersville Blower Corp., Connersville, Ind., has recently added to its line the new single-stage, Type OIC, centrifugal compressor which is adapted to direct motor or turbine connection, but is also available for use with belt drive. Compressors are available with aluminum or alloy steel impellers and cast-iron casings, although special alloys to resist corrosive or abrasive action may be had. The smaller sizes employ open impellers and anti-friction bearings and the larger sizes, sleeve bearings and closed impellers.

Improved Rubber Lining

Greater resistance to both acids and alkalis is claimed for a new hard-rubber lining for tanks that has been announced under the designation of M R-10 by the American Hard Rubber Co., 11 Mercer St., New York City. The lining possesses a highly glazed surface, as is indicated by the accompanying illustration, and is bonded securely to a relatively thin layer of soft rubber which is vulcanized to the steel tank, providing an elastic connection to compensate for thermal changes and protect against shocks. In the installation of this lining, soft rubber fillets are used at all corners.

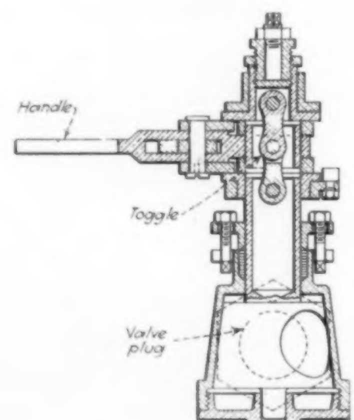
The compound used for the lining has been improved in pliability and, on account of the high gloss surface, is easier to clean. Acid resistance is said to be better, permeability less, and the cost no higher.

Section of highly glazed rubber lining

This concern has also announced a new hard-rubber pump, which is described as Type W A M. It has a capacity up to 90 g.p.m. at 12 ft. head and employs a hard-rubber casing said to be resistant to acids, heat and distortion. The casing is attached to the base by means of a hard-rubber-covered casting which serves as a chamber to catch drip from the stuffing box. An adjustable bypass is cored into the back casing. All parts are interchangeable.

Self-Sealing Plug Valve

For handling steam, air, gas and many liquids the new lever-operated Thru-Flow valve has recently been developed by Golden-Anderson Valve Specialty Co., Fulton Bldg., Pittsburgh, Pa. This valve is of the straight-through plug type, designed to seal itself automatically in both the open and closed positions, without the use of lubricant and without special attention.

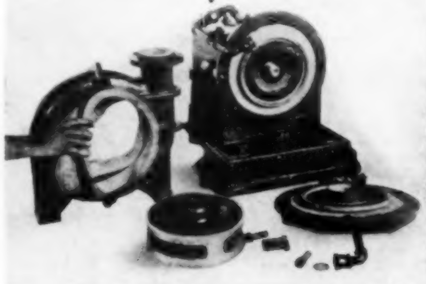


Cross section of new self-sealing plug valve

Construction of the valve is explained by the accompanying illustration. When the handle is moved either toward the open or closed position the first effect is to unseat the plug so that it can be turned readily. This unseating produces a positive clearance, thus avoiding friction and rubbing wear. When the plug has been rotated to its other extreme it is stopped by a lug so that further movement of the handle, through a crank system, breaks the toggle and lifts and seals the plug. When the valve is again to be moved to its other position the first movement of the handle straightens the toggle, dropping and freeing the plug before any rotary movement of the plug can take place.

Rubber Pump Lining

Allen-Sherman-Hoff Co., 225 South 15th St., Philadelphia, Pa., has announced the development of a complete soft-rubber lining for use in connection with the Hydroseal sand pumps which the company manufactures for the handling of liquids containing abrasive solids. It will be recalled that the Hydroseal pump, which is of the centrifugal type, prevents short-circuiting through the clearances between impeller, suction and discharge by forcing a small flow of clear liquid through these clearances against the pump pressure. By the use of the company's new Maximix rubber parts, it is claimed that abrasive wear is reduced to such an extent that the linings outlast the best alloy steels four to one. As the accompanying illustration shows, replacement of the lining parts is easily accomplished because they are not vulcanized to the casing. It is claimed that complete protection is afforded and that the material pumped cannot touch any metal part.

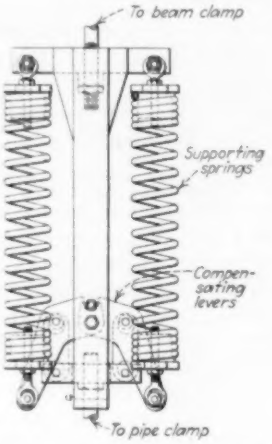


Disassembled view of pump showing rubber lining parts

Constant-Support Pipe Hanger

Grinnell Co., Providence, R. I., and the General Spring Corp., 11 West 42d St., New York City, have announced the development of the Genspring constant-support pipe hanger, a device which is adapted for use with all sorts of high temperature piping, where a flexible support is required to avoid

strains set up by thermal changes. The new hanger, as appears from the drawing, employs springs to support the weight of the pipe through a pair of levers which compensate for the exten-



New constant-support pipe hanger

sion of the springs. In the usual type of spring hanger the supporting effort varies with the deflection of the springs, thus introducing strains in the pipe. With the new hanger the pipe is free to move in any direction, but receives equal support in every position. The hanger is made in three sizes and each size three lengths of travel.

Equipment Briefs

After considerable experimental work, the B. F. Goodrich Co., Akron, Ohio, has developed a new liquid belt dressing for rubber belts, said to be far superior to anything previously in use. It is stated that this material will increase pulley grip without deeply penetrating and deteriorating the body of the belt.

A new emulsifier for general laboratory work has recently been developed by the Hills-McCanna Co., 2349 Nelson St., Chicago, Ill. The machine has a reservoir capacity of 1 qt. and is intended for continuous operation. The emulsifier employs a rotor-type pump which creates a vortex that brings the lighter substance down to the pump suction, making possible, it is said, a rapid and complete emulsification.

Beryllium Products Corp., New York City, has announced a new beryllium-nickel alloy which can be heat-treated to produce a Brinnell hardness of 460 and is said to produce a sharp cutting edge. The material is reported to be particularly resistant to intergranular corrosion in contact with mineral acids. Fully hardened, the alloy has the tensile strength of 260,000 lb. per sq.in. and an elongation of 8 per cent.

Through the use of a selective five-speed, push-button controller, complete control of the operating speed of hoists has been made possible, according to the Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y. The five speeds are controlled with a single button, the operator feeling the change as each of the five independent speeds is obtained when the button is pressed or released. All five speeds are usually obtainable for lowering; in the case of lifting, the number of speeds will depend upon the load.

A novel type of steam jet for injecting steam for heating purposes into highly corrosive solutions has been developed by Heil & Co., 12502 Berea Rd., Cleveland, Ohio. The jet is made of an impervious carbon compound, and is said to have shown long life in combinations of pickling acids which may include hydrofluoric, nitric and hydrochloric acids.

Patterson Foundry & Machine Co., East Liverpool, Ohio, has announced "Porox 66," a new synthetic silicate grinding ball for use in pebble, ball and tube mills. It is said that this ball offers greater resistance to abrasion than other grinding media, and that it cannot split, chip or fracture.

For the handling of all solutions which do not attack bronze, the Dorrler Machine Works, 21 Crescent St., Brooklyn, N. Y., has developed a new 300 g.p.h. rotary, gear-type, pressure pump, complete with direct-connected, $\frac{1}{4}$-hp., a.c. motor. The new pump employs a bronze casing and stainless steel gears and shaft. It contains an easily removable perforated metal strainer.

An industrial, fan-type, electric heater, said to be free from fan noise, and made in both portable and stationary models, is being offered by the Harold E. Trent Co., 618 North 54th St., Philadelphia, Pa. A thermal cutout is provided which operates should the fan motor stop. The heating element is of this company's tubular type, and is said to give even temperature and perfect distribution of heat.

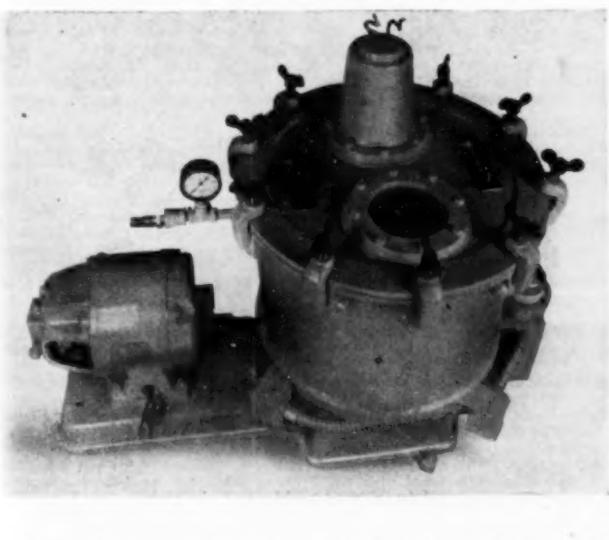
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., has developed a new differential humidity control, designed to control the humidity inside buildings at a level commensurate with the outside temperature so that all wall and window condensation will be avoided. The instrument is really two instruments in combination, one of which controls the humidity in normal fashion until the other, an outside temperature controller, acts to reduce the humidity as outside temperature falls.

For brazing both ferrous and nonferrous metals, and for use particularly with this company's silver solders and brazing alloys, Handy & Harman, 82 Fulton St., New York City, has introduced a new flux known as "Handy Flux." The new material is said to have greater solvent action on a wide variety of oxides, thus assuring wetting of the joint surfaces and speeding up brazing.

Incorporating all the features found in the larger models of its colloid mills, the Chemicolloid Laboratories, Inc., 44 Whitehall St., New York City, has introduced a new portable, laboratory-model, Charlotte colloid mill which is provided with a 1-hp. motor and starter. The mill operates at 3,600 r.p.m., and weighs 200 lb. It is water-cooled and has a $\frac{3}{4}$ in. inlet and $\frac{1}{2}$ in. outlet. All parts of the mill in contact with the material are of Monel metal.

A new type of construction, built around a woven tubular reinforcement of strong cabled cotton cords and wire, is employed by the Electric Hose & Rubber Co., Wilmington, Del., in its new Delmar suction hose, which is made in sizes up to 4 in. inside diameter. This construction is said to be very strong and light, with high flexibility and non-collapsibility.

New developments announced by the Lincoln Electric Co., Cleveland, Ohio, include a new close-coupled, gas-engine-driven arc welder of 300 amp., 40 volt capacity, and a new heavily-coated,



De-Airing Mixer

The accompanying view shows the exterior of a new laboratory-size Simpson intensive mixer, made by the National Engineering Co., 549 West Washington Blvd., Chicago, Ill., which is equipped with vacuum for de-airing with and heating elements for temperature control during mixing. This is believed to be the first time that a mixer employing the mulling principle has been so equipped.

general purpose electrode. For the welder greater compactness, lighter weight and lower gasoline consumption are claimed. The unit may be mounted on wheels for portability. The electrode, "Fleetwood No. 7," is intended for shielded-arc work on mild steel and has been designed especially for high speed and single-pass welding. Welds show tensile strength of 70-80,000 lb. per sq.in., and elongation of about 20 per cent in 2 in.

MANUFACTURERS' LATEST PUBLICATIONS

Accumulators. Seamless Steel Equipment Corp., 39 Broadway, New York City—4 pages on hydraulic compressed-air accumulators supplied by this company.

Ammonia. The Barrett Co., 40 Rector St., New York City—15 pages on uses of ammonia in petroleum refining.

Apparatus. W. H. & L. D. Betz, 235 West Wyoming Ave., Philadelphia, Pa.—20-page booklet on equipment, chemicals and methods for water analysis.

Belting. Graton & Knight Co., Worcester, Mass.—20-page catalog on this company's power transmission belting and accessories.

Castings. Buffalo Foundry & Machine Co., Buffalo, N. Y.—Bulletin 283—4 pages on alloy iron chemical castings.

Castings. Chain Belt Co., Milwaukee, Wis.—4-page folder describing this company's services in the production of malleable iron castings.

Cements. Thiokol Corp., Yardville, N. J.—Leaflet describing new rubber-like cements, resistant to hydrocarbons, made by this company.

Chemicals. E. I. duPont de Nemours & Co., Rubber Chemicals Division, Wilmington, Del.—11-page booklet giving the story of Duprene.

Chemicals. Glyco Products Co., 949 Broadway, New York City—Catalog on emulsifying agents, synthetic resins, synthetic waxes, etc., supplied by this company.

Chemicals. R. & H. Chemicals Dept., E. I. duPont de Nemours & Co., Wilmington, Del.—Two leaflets of technical data, one on beta trichlorethane and the other hexachlorethane. Also quarterly price list, January, 1935, on this company's chemicals.

Clutches. Magnetic Mfg. Co., Milwaukee, Wis.—Bulletin 200—Describes this company's standard line of multiple-disk magnetic clutches in sizes 6 in. and larger.

Colloid Mills. Chemicolloid Laboratories, 44 Whitehall St., New York City—4-page folder describing a new line of portable laboratory colloid mills made by this company.

Compressors. Chicago Pneumatic Tool Co., 6 East 44th St., New York City—Bulletin 728—16 pages on the construction of this company's Type T horizontal, single-stage compressors.

Compressors. Spencer Turbine Co., Hartford, Conn.—12-page catalog describing this company's complete line of turbo-compressors, including gas-tight compressors for acid and explosive gases.

Control. Continental Electric Co., St. Charles, Ill.—Form PC2—6-page folder on the several styles of photoelectric cell made by this company.

Crushers. Pennsylvania Crusher Co., Liberty Trust Bldg., Philadelphia, Pa.—Bulletin 5010—4 pages on primary jaw crushers made by this company.

Electroplating. The Udylite Co., 1651 East Grand Blvd., Detroit, Mich.—4-page folder describing an electroplating rheostat offered by this company.

Equipment. Binks Mfg. Co., 3106 Carroll Ave., Chicago, Ill.—32-page booklet on spray guns, spray booths and other equipment; 8-page bulletin on indoor forced-draft cooling towers; 8-page bulletin on atmospheric spray-cooling towers.

Equipment. Denver Fire Clay Co., Denver, Colo.—General Catalog 12—664-page general catalog on refractories, metallurgical laboratory equipment, measuring instruments, chemicals and reagents, etc., available to engineers and others located in this company's territory.

Equipment. Downingtown Iron Works, Downingtown, Pa.—32 pages illustrating the wide range of carbon steel and alloy plate equipment fabricated by this company.

Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-1440C, Electric arc welders; GEA-1450B, Turbines for mechanical drive; GEA-1546B, Welding electrodes and accessories; GEA-1914, Floodlights; GEA-2024, 2044, Turbines for mechanical drive; GEK-86, Metal-enclosed switchgear.

Equipment. Ingersoll-Rand Co., Phillipsburg, N. J.—Form 2152—6 pages on a new pneumatic impact wrench made by this company; Form 9212, 12 pages on compressor intercoolers for air and gas.

Equipment. Leader Iron Works, Decatur, Ill.—6-page folder descriptive of brass and copper columns, tanks, heat exchangers and other equipment made by this company.

Equipment. M. W. Kellogg Co., 225 Broadway, New York City—4 pages on this concern's large refinery equipment.

Equipment. Semet-Solvay Engineering Corp., 40 Rector St., New York City—Pamphlet 382—Leaflet describing this company's new three-way backrun valve for water gas machines.

Equipment. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.—Folder WG-1804—4 pages on this company's eye-line water level indicators for boilers.

Filtering. Carl Schleicher & Schuell Co., 167 East 33d St., New York City—135-page handbook on laboratory filtration.

Forgings.—Kropp Forge Co., 5301 West Roosevelt Rd., Chicago, Ill.—4-page folder descriptive of this company's services in supplying heat-treated forgings.

Gas Masks. Mine Safety Appliances Co., Pittsburgh, Pa.—Bulletin EA-1—4 pages describing the Burrell all-service gas mask.

Glass. Fish-Schurman Corp., 230 East 45th St., New York City—Leaflet describing products of Jena Glass Works, commenting briefly on this company's 50 years of manufacturing progress.

Grinding. Traylor Engineering & Mfg. Co., Allentown, Pa.—Circular 95—4-page leaflet explaining why bell-shaped crushing heads must be used with curved concaves in gyratory crushers.

Instruments. American Meter Co., 60 East 42d St., New York City—Publications as follows: E-3, Catalog and instruction bulletin on indicating flowmeters; AG-1, Meter proving apparatus; AG-3, Wet and dry test meters; AG-4, Demand meters; AG-6, Service cleaners; E-15, Orifices; E-21, Recording gravity meters; EG-40, Iron-case meters; E-5, Level controllers; E-12, base pressure and volume indexes.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 1134—4 pages on the use of recording instruments in industrial research; also booklet on the use of recording instruments in locating waste in industry.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 192—4 pages describing this company's indicating potentiometer pyrometers.

Instruments. The Hays Corp., Michigan City, Ind.—Bulletin 2018—Leaflet describing this company's electric contact draft gages.

Instruments. Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 18-R—25 pages on this company's Rotameters for flow measurement of liquids and gases, including several new types.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Bulletin 1101—16 pages describing the complete line of photoelectrically actuated pyrometers made by this company.

Instruments. Taylor Instrument Cos., Rochester, N. Y.—Form 6016—8 pages on an instrument made by this company for recording press-roll pressure on paper machines.

Instruments. Weston Electrical Instrument Corp., Newark, N. J.—12-page catalog briefly describing recent instruments for measuring and controlling, including Photronic devices, relays and meters.

Mixers. Alsop Engineering Corp., 39 West 60th St., New York City—Bulletin G.I.411—4 pages on portable electric mixers, filters, bottling equipment and glass-lined tanks.

Mixers. Patterson Foundry & Machine Co., East Liverpool, Ohio—4 pages describing portable mixers and Unipower agitators.

pH Control. Pfaltz & Bauer, 300 Pearl St., New York City—List No. 3—6-page folder describing pH testing by the indicator strip method.

Pipe Hangers. Grinnell Co., Providence, R. I.—Catalog 7—General catalog on adjustable pipe hangers and supports; Bulletin A-12, leaflet describing the new Genspring constant-support pipe hanger.

Power Transmission. Foot Bros. Gear & Machine Co., 5301 South Western Blvd., Chicago, Ill.—Bulletin 600—12 pages describing power transmission equipment for breweries.

Pumps. Lawrence Pump & Engine Co., Lawrence, Mass.—Bulletin D-29—6 pages on "custom-built" stock pumps made by this company.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind. — Bulletin 60-B10 — 4 pages describing this company's rotary cycloidal pumps for heavy-duty liquid and vacuum service.

Pumps. Worthington Pump & Machinery Corp., Harrison, N. J.—W-312-B2A, Single-stage volute centrifugal pumps; W-312-B4, Single-stage volute centrifugal pumps; L-611-B3, 4 pages describing steam booster compressors.

Rectifiers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Folder 1168—20 pages with description and engineering data on this company's mercury-arc rectifiers for electrolytic plants.

Refractories. Harbison-Walker Refractories Co., 1800 Farmers Bank Bldg., Pittsburgh, Pa.—Folder briefly describing several types of light-weight insulating brick made by this company.

Refractories. McLeod & Henry Co., Troy, N. Y.—Catalog 235—32 pages on this company's refractory shapes for furnace linings and arches.

Refrigeration. Carbondale Machine Corp., Carbondale, Pa.—Bulletin W-207-E17—10 pages on capacity and design standards for steam jet refrigeration.

Rubber Goods. B. F. Goodrich Co., Mechanical Division, Akron, Ohio—23-page catalog on belting, hose and other mechanical rubber goods for industrial service.

Steam Generation. Edge Moor Iron Co., Edge Moor, Del.—Folder announcing this company's agency for Whiting pulverizers and listing the company's varied services in connection with steam generation.

Steam Generation. Northern Equipment Co., Erie, Pa.—Folder 137—Article on "Operating Experience at Masonite With High-Pressure Boiler Feed Control."

Steam Generation. Steam Generator Corp., 222 West Adams St., Chicago, Ill.—Bulletin No. 1-34—8 pages on industrial, water-wall, unit steam generators made by this company.

Stoneware. U. S. Stoneware Co., Akron, Ohio—Bulletin 403—8 pages on acidproof stoneware jars, tanks, stills and mixers.

Testing. Electro-Alloys Co., Elyria, Ohio.—Reprint of an article on X-ray inspection of high alloy testing.

Timers. Walser Automatic Timer Co., Chrysler Bldg., New York City—4 pages on a variety of automatic timers made by this company.

Tornesit. Hercules Powder Co., Wilmington, Del.—20-page book on the properties, uses, history and chemistry of the new chlorinated rubber base, Tornesit.

Traps. Sarco Co., 185 Madison Ave., New York City—Bulletin 49—Leaflet describing a new thermostatic trap for pressures up to 200 lb.

Trucks. The Fairbanks Co., 393 Lafayette St., New York City—Catalog 955—16 pages on hand trucks made by this company.

Valves. Merco-Nordstrom Valve Co., 400 North Lexington Ave., Pittsburgh, Pa.—Service chart describing proper care of this company's lubricated plug valves; 32-page bulletin describing lubricants for these valves, specifying correct lubricants for different services.

Valves. Central Brass Mfg. Co., 2950 East 55th St., Cleveland, Ohio—8-page booklet describing brass valves, faucets and fittings made by this company.

Welding. Air Reduction Sales Co., 60 East 42d St., New York City—Folder describing coated welding electrodes supplied by this company.

Welding. Lincoln Electric Co., Cleveland, Ohio—Bulletin 308—Folder on specifications of Types SAC300 and 500 motor-driven arc welders.

FURTHER OBSERVATIONS ON NEW EQUIPMENT AT THE POWER SHOW

IN THE December, 1934, issue of *Chem. & Met.* was the initial installment of the story of new equipment on display at the Eleventh National Exposition of Power and Mechanical Engineering, held in New York during the week of December 3. New equipment of interest to chemical engineers was so abundant, however, that the entire array could not be described at that time. The first article discussed instruments, power transmission equipment, pumps and blowers, valves and fittings, water treatment equipment and a new type of insulation. The concluding article, below, goes on to equipment for air conditioning, filtration, and dust handling, to various steam specialties and to a number of interesting miscellaneous items.

Air Conditioning

A method of humidity control, developed by C. R. Downs and offered by the Research Corp., New York City, was demonstrated. This device, known as the Calorider, employs a combination of calcium chloride and other materials for dehumidification and deodorizing of air. The system is adapted both to industrial work and to comfort air conditioning. The air passes through numerous cascades of solution and sweeps over shallow trays containing the liquid. After it is partially dry, it passes through lump Caloride where additional absorption of moisture reduces the relative humidity to about 25 per cent. Cooling coils are supplied to remove the small quantity of heat liberated during the drying. For winter operation, the Caloride is removed and warm water put into the apparatus to increase air humidity to the desired extent.

This same company also showed an operating model of the new Coey multistage cooling tower. Through the use of stage construction, the air is given a long travel in a short tower, passing over the water three times before it discharges. Air flow is maintained by a centrifugal fan. The flow of air is counter to the water flow.

Dust Separators

Research Corp., New York City, showed a rough classifier for dust, known as the inertia impact classifier. The dust is made to take a tortuous path whereby the coarser particles are skimmed from the stream and discharged into a hopper. Prat-Daniel Corp., New York City, demonstrated a dust-handling device which has been given the name Thermix venturi dust trap. The apparatus consists of a series of vertical venturi-shaped passages through which the gas or air carrying the dust passes horizontally. In the walls of each venturi at the throat are slots connecting at the bottom with the dust bin and at the top with a bypass to remove whatever gas passes through the slots with the dust. Since the resistance of such an apparatus is very low, its collection efficiency can be made high by adding additional venturis and slots in the path of flow.

Filters

Two interesting new filters were shown. A line of metal industrial Purolators, ranging in size from an element no larger than a stub of lead pencil to one passing 10,000 g.p.m., was exhibited by the Motor Improvements Corp., Newark, N. J. This concern has developed an embossed metal strip which is wound edgewise on a corrugated cylinder so that the embossed points act as separators to control the opening between adjacent windings. The smallest slot width so far used is 0.0005 in. This construction has been developed in several metals for many industrial and chemical uses. As the device operates on the edge-filter principle, cleaning is readily accomplished by means of a rotary scraper.

Commercial Filters Corp., Boston, Mass., showed a clarifying filter tube consisting of bleached cotton yarn wound in honeycomb pattern on a wire mesh core. This is the basis of the so-called Full-Flow filter which has been used for oils, food products and alcoholic liquors.

Steam Equipment

Permutit Corp., New York City, exhibited a new plate-type heat exchanger for use in continuous boiler blow-off and for all heat exchange purposes where easy cleaning and ready increase of surface are necessary. The exchanger consists of a bundle of sections firmly bolted together, composed of solid castings to withstand high pressures.

An interesting rotary pressure joint, requiring no lubrication, was shown by the Johnson Corp., Three Rivers, Mich. This device is suitable for connecting steam, gas or liquid supplies to rotating rolls or other equipment at pressures up to 200 lb. and at speeds up to 600 r.p.m. Employing spherical joints operating against special composition seal rings, the device has considerable angular and lateral flexibility and low frictional resistance.

Grinnell Co., Providence, R. I., exhibited what is called the Genspring constant support hanger for pipelines subject to considerable temperature changes. This hanger is a spring and linkage device which floats the pipeline with complete freedom for movement in any direction, at the same time affording constant and adequate support throughout the entire range of vertical and horizontal movement.

A new thermostatic trap brought out by the Sarco Co., New York City, is useful for pressures up to 200 lb. and incorporates a new stop which surrounds and protects the bellows element, preventing over-travel.

An interesting tube cleaner for heat exchangers and boiler tubes was shown by the Tubrush Corp., Boston, Mass. A cylindrical body carries wire brush bundles with sharp cutting edges, arranged to slide in the body and so produce exact centering. This same concern showed a recent design of labyrinth packing which should be interesting for use in autoclaves and other pressure equipment requiring the packing of an agitator shaft. The packing should also be of value on centrifugal pumps. The novel feature of this packing is that the labyrinth is disposed radially instead of along the shaft, thus requiring very little space, yet still giving maximum packing effect. The feature of this type of packing, of course, is that there is no actual contact between the rotating and the stationary members.

Miscellaneous

An industrial fire extinguisher of the hand-pumped type, made in 1 or 2 qt. sizes, was demonstrated by the Wil-X Mfg. Co., Brooklyn, N. Y. Its novel pump is outside the body of the extinguisher and is pivoted to the top through a special joint arrangement. Should the pump be damaged it can quickly be changed. Furthermore, direction of the stream through the end of the pump, rather than from the bottom of the cylinder, is said to be more accurate and easier to control. A special extinguishing liquid of low freezing point and harmless character is employed.

One further development, useful for the remote control of valves, switches, clutches and other equipment, was shown by the Boston Gear Works, Boston, Mass. This is known as the Reynold remote control and consists of a series of elbow fittings and straight sections through which operate roller chain and rods, controlled by a detachable control handle. This device is effective for distances up to at least 100 ft. It operates successfully in any direction and around corners.

Chemical Engineering NEWS

Tercentenary of American Chemical Industries

THREE centuries of chemical industry in America will be celebrated by a special program at the 89th meeting of the American Chemical Society to be held in New York the week of April 22. Chemical industry will join with members of the Society in demonstrating the essential part it has played in the development of this country from early beginnings in the colonies to its present dominant position in our industrial life.

Several important innovations in the arrangement of the program for the week have been necessary to allow everything desired to be put into the short space of six days. Wednesday morning has been set aside for the council meeting. Eminent speakers from among the leaders of American chemical industry will present industry's views at the general meeting and banquet on Wednesday afternoon and evening. The members of the Society will be asked to participate with the New York Section on Tuesday evening in honoring Rev. J. A. Niewland, chosen the Nichols Metallist for 1935 for his work on acetylene and its derivatives upon which the present manufacture of a synthetic rubber is based.

In order to provide adequate opportunities for all members to see those of the many plants in the metropolitan area of most interest to them, plant visits have been put in charge of the several divisions of the Society and will form definite parts of divisional programs. Already some thirty trips have been tentatively planned, many of which can be repeated if desired, to give visitors ample opportunity to see the plants they desire.

Hotel Pennsylvania has been selected as the headquarters hotel and its generous facilities are to be amplified by the New Yorker, the Governor Clinton and the McAlpin, all within two blocks of the headquarters. Other hotels will be used as required to care for those who cannot be accommodated in one of these. All meetings will be held in the Pennsylvania except those of the Rubber Division, which will be housed at the New Yorker, and of the Paint and Varnish Division, at the Governor Clinton. Each of these hotels is in a position to meet any special living room requirements of individuals or groups if they are made known to the Committee in advance.

Francis P. Garvan will be the honorary chairman of the meeting, with Prof. Arthur W. Hixson of Columbia University the general chairman. Mrs. F. P. Garvan is the honorary head of the Ladies Committee, with C. F. Roth as general chairman. Other committee chairmen include: reception, E. M. Allen; general advisory, P. E. Landolt; finance, A. Cressy Morrison; auditing, R. T. Baldwin; general entertainment, H. C. Parmelee; banquet, F. D. Snell; registration, A. B. Newman; plant visits, S. D. Kirkpatrick; transportation, J. C. Olsen; social, V. K. La Mer and Lela E. Booher; hotels, W. W. Winship; group dinners and luncheons, L. T. Work; golf, C. R. De Long; publicity, D. H. Killeffer; printing, H. B. Lowe; information, S. D. Swan

New Research Laboratory Opened by Du Pont

ON Jan. 22, E. I. du Pont de Nemours & Co. dedicated and opened its new medical research laboratory to be known as the Haskell Laboratory of Industrial Toxicology, the purpose of which will be to test, from a health standpoint, all products produced by the company before they are placed on the market.

The exercises in connection with the dedication of the laboratory consisted of a scientific meeting in the morning at which addresses were made by Dr. R. R. Sayers, medical officer in charge of the office of Industrial Hygiene and Sanitation of the Public Health Institute, Washington, D. C., on "Relations Between Government and Industrial Hygiene." There were also addresses by Dr. G. H. Gehrmann, medical director of the DuPont company, who spoke on "Development of Industrial Medicine," and by Dr. W. F. von Oettingen, director of the laboratory on "The Problems of Industrial Toxicology."

The afternoon was spent in inspection of the laboratory facilities and the ceremonies were concluded with a dinner at night at which addresses were made by Lammot du Pont, president of the company, vice-president Harry G. Haskell for whom the laboratory is named, and by Dr. Gehrmann and Dr. von Oettingen.

Priestley Lectures at Penn. State

THE ninth annual Priestley Lectures at Pennsylvania State College will be given in the Chemistry Amphitheatre at State College, Pa., each evening from April 29 to May 3 inclusive.

These lectures constitute a memorial to Joseph Priestley whose old home at Northumberland, Pa., is now owned and maintained by the alumni of the college. A museum, containing all the Priestley relics which could be gathered together, now stands near the house.

This annual series of lectures was inaugurated by the faculty in 1926. In 1931, Phi Lambda Upsilon (honorary chemical society) undertook the financial support of the Priestley Lectures.

Each year the lectures deal with the borderline between physical chemistry and chemical physics and some other branch of knowledge. This year's Priestley Lectures deal with the borderline between physical chemistry and electrometallurgy. They will be given by Matthew A. Hunter, D. Sc., professor of electrochemistry and head of the department of physics and electrical engineering, Rensselaer Polytechnic Institute.

California Sulphur Deposit Will Not Be Worked

DEFINITE decision not to attempt the development of the sulphur deposit in lower California prospected by the Jefferson Lake Oil Co., Inc., New Orleans, during the past summer has been reached by officials of that corporation. The company now produces sulphur at Lake Peigneur, near New Iberia La. After an extended engineering examination it was found that the sulphur deposit, which is located about 150 miles south of Calexico, California, was not susceptible of commercial operations.

The company recently started a drilling operation to definitely determine the further extent of the sulphur deposit found in the large salt dome caprock beneath Lake Peigneur, from which it is now producing.

Shellac Research at Brooklyn Poly

NEGOTIATIONS have recently been completed between the Polytechnic Institute of Brooklyn and the United States Shellac Importers' Association for an enlargement of the cooperative research work on shellac which has been carried out by the Polytechnic Institute during the last six and one-half years.

The project is part of an international research program which is sponsored by the United States Shellac Importers' Association and the Government of India through its Lac Cess Committee. This committee maintains the Indian Lac Research Institute at Ranchi, India, and the London (England) Shellac Research Bureau. The results of the investigations carried out at these three centers of research will be exchanged in order to avoid duplication of effort.

Plans at the Polytechnic Institute include an enlargement of the permanent staff who are engaged in carrying out this cooperative research. This staff will consist of a research supervisor, an associate, assistant and two research fellows. In addition the cooperative agreements provide for the deputation of Indian scientists to the staff at the Polytechnic Institute. Men trained in English universities will probably be chosen for these appointments.

Two fellowships of $800 per year, with remission of tuition fees, will be available to graduate students pursuing doctorate work. These men will have their Master's degrees and devote at least half of their time to research on shellac. This research can be used for theses. One of the fellows will be a chemist or chemical engineer, while the second will be an electrical engineer.

A new laboratory at the Polytechnic Institute is being constructed to accommodate the expanded work which will be under the supervision of Prof. Wm. Howlett Gardner. He will also act as the Institute's representative in cooperating with the technical representatives of the other interested parties.

Natural Organic Products Code Approved

APPROVAL of a code of fair competition for the natural organic products industry was announced on Jan. 28 by the National Industrial Recovery Board. It became effective Feb. 4.

Comprising five distinct divisions, all of which originally submitted individual codes for NRA approval, the industry reported a $50,000,000 volume of business in 1929 and a $25,000,000 volume in 1932. It is composed of about 170 establishments and employed about 1,958 workers in 1929.

Because of overlapping functions and problems common to all five divisions, the industry was asked to combine under one basic code. A single trade association was formed to sponsor the code, members of all five divisions being admitted to membership.

A 40-hour maximum work week, a 35 cent minimum wage rate, and other general labor and administration provisions are common to all divisions.

The botanical drug industry, the essential oil industry, the spirit and oil soluble gum industry, the water soluble gum industry and the vanilla bean industry will each have its own administrative agency—a divisional code council. Each division has a separate schedule of trade practice rules.

A Code Authority to consist of one member from each of the divisional councils will be established to administer the basic code. Pending the election of a permanent Code Authority, the Board of Directors of the sponsoring association will constitute a temporary agency which will supervise all matters pertaining to code administration.


Wide World

W. R. Whitney Receiving Edison Medal From R. B. Bonney, vice-president A.I.E.E.

Willis R. Whitney was awarded the Edison Medal for 1934 of the American Institute of Electrical Engineers. Dr. Whitney was selected for the honor "for his contributions to electrical science, his pioneer inventions and his inspiring leadership in research." The award is made annually for "meritorious achievement in electrical science, electrical engineering, or the electrical arts" by a committee made up of 24 members of A.I.E.E.

First Large Sale of Coke Ovens in Several Years

THE Public Service Electric and Gas Co., of New Jersey, a subsidiary of the Public Service Corp. of New Jersey, has awarded a contract to The Koppers Construction Co. for an addition to its Camden, N. J., gas plant. The addition will practically double the capacity of the plant.

The contract provides for the construction of 37 byproduct coke ovens of the Becker type. These will have a daily capacity of 600 tons of coal and will produce, in addition to gas, coke, tar, ammonium sulphate and other products.

The contract provides for the first large installation of byproduct coke ovens in several years. The general business depression brought the construction of new byproduct coke ovens to a halt. The fact that the steel industry's requirements were fairly well supplied, along with the rapid development of natural gas systems, also tended to stop new construction of byproduct coke plants.

New Solvent for Rubber Announced by Du Pont

A SOLVENT for synthetic rubber as well as natural rubber has just been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. This new solvent is beta-trichlorethane, a non-flammable, water-white chlorinated hydrocarbon.

Besides its unique solvent power for rubbers, beta-trichlorethane has a rapid and powerful solvent for such organic materials as oils, fats, waxes, tars and natural resins. It is miscible with alcohol, ether, and many other organic solvents, but is practically immiscible with water.

Other properties of beta-trichlorethane include a boiling point of 114 deg. C., a specific gravity of 1.4406, and high stability in the presence of light and water. Because of this last property, it is non-corrosive to most materials.

Commercial Solvents Buys Molasses Companies

ANNOUNCEMENT has just been made to the effect that Commercial Solvents Corp. in conjunction with Corn Products Refining Co. had completed negotiations for the purchase of the business and properties of the Molasses Products Corp. and of the Dunbar Molasses Corp. It is reported that a new company will be formed in which Commercial Solvents will have a two-thirds interest and Corn Products Refining Co. a one-third interest.

NEWS FROM WASHINGTON

By PAUL WOOTON

Washington Correspondent of Chem. & Met.

WASHINGTON seethes with reform. Remodeling of the banking structure, regulation of holding companies, continuance and enlargement of regulatory activity, all are receiving executive and Congressional consideration. Defeat of the President in his fight for adherence to the World Court has not in any measure reduced the momentum of attempted internal reform.

Chemical industry can confidently expect a continuance of NRA on much the same basis for at least one, probably two, years beyond its present expiration date in June. Continuation without much modification of the law seems necessary now that the President and organized labor are so far apart.

Continuance of AAA activity on a more vigorous plan, but also a more clean-cut business-like basis, may also be forecast. Elimination of over-zealous New Dealers from the legal group means that Administrator Chester Davis is now really the boss, and that tentative agreements reached between the Administration and industry will not be slyly mussed up or held up by subordinates who happen to disagree with policy decisions.

The President's authority for administration of the executive departments is greatly enlarged by the work relief appropriation bill, even though that measure as enacted bears only superficial resemblance in form to the original proposal. Already the President has also tremendously enlarged spending power. Some estimate this at more than \$20 billion without new Congressional appropriation, of which the work relief bill provides a mere \$4.88 billion. Most of the rest of the flexibility comes from RFC collateral, PWA security holdings, gold profits, silver profits, and the authority to issue new bonds of a revolving-fund type. The last item is variously estimated as equal to \$9 or \$11 or \$12 billion. Accuracy even in billions closer than 10 or 20 per cent is not today expected in Washington.

The most serious threat to industry is not these huge powers of the President nor in extravagant spending with its prospective tax burdens. Much greater threat appears in the possible coalition of radicals who may force Left Wing compromises from the Administration against its best efforts and sincere wishes. There are several such groups whose forces if joined would be irresistible in the halls of Congress. Outstanding groups are for veterans' bonus, direct monetary inflation, old age pensions (Townsendites are the worst), free silver, organized-labor leaders (now definitely at outs with the White House). Any base on which a common log-rolling of desired measures could be arranged by these several groups would compel attention at the White House, regardless of Presidential desire or judgment.

The state of Texas has approached Secretary Ickes on a proposal to construct a natural gas pipe line from Panhandle to St. Louis and Detroit, preliminary to filing formal application for a combined loan and grant from PWA. Following a conference with R. B. Anderson, state tax commissioner, Ickes said that the project would utilize a vast volume of gas that is now going to waste and force down the rates for gas in the cities to be supplied.

A test showing how far the government is likely to go in lowering tariffs on manufactured goods in its reciprocal trade agreements is foreseen in the forthcoming treaty with Belgium in preparation for which a Belgian delegation is now in this country. Makers of cement, plate glass, and other products competitive with Belgian imports along the Atlantic seaboard are worried as to the outcome. In general, it is feared that the efforts which have been made to reduce farm surpluses and to protect agriculture will lead the tariff bargainers to do their swapping at the expense of industrial products.

Meanwhile a treaty with Brazil has been signed, the only one thus far approved with the exception of Cuba. Rates on manganese imports from Brazil, which furnishes 20 to 30 per cent of the manganese imports into the United States, have been cut in half. Duties have approximated 100 per cent ad valorem. This automatically effects a similar cut in duties from other countries of origin with the exception of Russia which furnishes 40 to 50 per cent of United States manganese imports. The total imports are 80 per cent of domestic consumption. Russia will not benefit from the treaty until several matters of direct negotiation with that country have been cleared up.

Brazilian tariffs have been reduced on several items of chemical interest including paints and varnishes, common soap, oil cloth, linoleum, patent leather, turpentine, and cement. Treaties with several other Latin American countries are pending. Immediate effects are confusing. For the first time since 1913, the United States finds itself with high tariff schedules against some countries and low ones against others. Any reduction of rates in a given treaty applies to the countries which already have an unconditional most-favored-nation status.

Trade observers in Washington are advising their clients to watch closely the schedule of hearings before the Committee on Reciprocity Information and to file briefs when their industry seems to be effected. In order to appear, a witness must file an advance brief at least one week before the hearing.

Several chemical items are involved in the proposed trade agreement with Canada on which hearings will be held March 11. Among the imports from Canada are: newsprint paper, sulphite wood pulp, unmanufactured asbestos, nickel ore, acetic or pyroligneous acid, ferromanganese, calcium cyanamide, sodium cyanide, ammonium sulphate, and gypsum. Exports to Canada include petroleum and derivatives, fertilizer, dyes, sulphur, sodium compounds, and pyroxylin products.

A revival of interest in trade development among chemical firms throughout the country is evidenced by an increasing demand for information from the Chemical Division of the U. S. Bureau of Foreign & Domestic Commerce. Last year, requests fell to a low ebb, partly due to general conditions and partly due to the fact that NRA codes and other matters were taking a large share of the time of plant executives. Subscriptions for monthly statistical statements on various branches of the industry and for weekly bulletins and foreign trade statistics are 40 to 50 per cent more than last year. Large firms which had cut their subscriptions down to one copy are requiring several copies to fill the needs of sales, purchasing, and other departments. The correspondence of the Chemical Division also has increased more than half over a year ago.

Intensive consideration of the problem of stream pollution has been undertaken by the National Resources Board with a view to defining an effective control policy for the future. Recent reports by the Board and the Mississippi Valley Committee put great emphasis on the present confusion in regulating disposal of domestic and industrial wastes arising from jurisdictional and other legal problems.

For a detailed review of the problem H. R. Crohurst, sanitary engineer of Public Health Service and an authority on the subject has been detailed to the National Resources Board to prepare a

report covering its detailed phases within 60 days and an advisory committee has been appointed composed of W. B. Bell, Biological Survey; Col. Glen Edgerton, Corps of Engineers; A. C. Fieldner, Bureau of Mines; Elmer Higgins, Bureau of Fisheries; Thorndike Saville, Water Resources Section of the National Resources Board; R. E. Tarbett, Public Health Service and Abel Wolman, Maryland State Department of Health.

The National Resources Board does not expect to discover any simple solution of the problem which involves both diversity in agencies and methods for enforcement of statutory and administrative restrictions and technical questions relating to domestic sewage treatment and treatment and recovery of industrial wastes.

An investigation of the possibilities of industrial use of whole cotton for the manufacture of cellulose or other materials than lint cotton would be provided for in a bill that has been introduced in the House by Representative Fulmer of South Carolina.

The measure would appropriate $150,000 for the creation of an experiment station under the Department of Agriculture to study the question and to cooperate with other persons or organizations interested in the same work.

Designed to provide for better utilization of all Southern agricultural products, the bill also provides for investigations with respect to commercial uses for bagasse, cotton stalk, cottonseed, moats, cotton hulls, cotton lint and linters, and rice straws.

In the hearings on the Netherlands treaty, before the Committee for Reciprocity Information Feb. 4, Francis P. Garvan, president of the Chemical Foundation, warned that discriminatory tariff concessions may lead to tariff reprisals by nations outside the agreements. He argued against granting trade advantages which may react to the advantage of the international nitrate cartel.

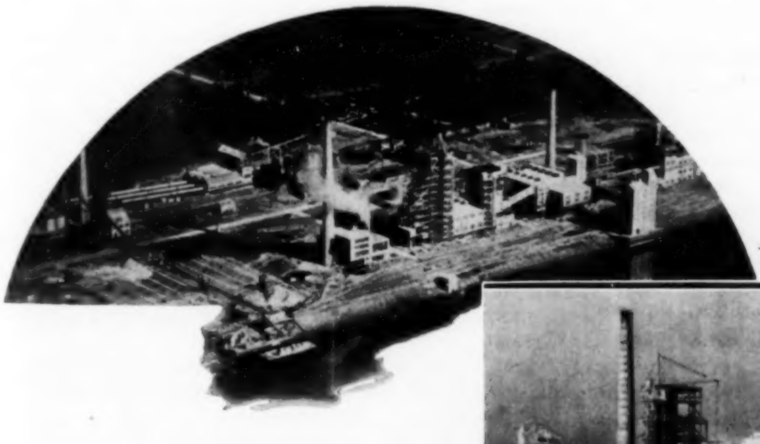
F. X. A. Eble, representing American match manufacturers, asked inroads of Russian and Japanese matches upon the domestic market by given consideration in framing protective provisions and that the Dutch embargo on American matches be relaxed. H. D. Meincke of A. M. Meincke & Son, Inc., asked that the 2c. per pound duty on paperine, a chemically treated starch made in the Netherlands and used in treating paper, be reduced. A lowering of rates on vegetable oils was supported by the Bureau of Raw Materials for American Vegetable Oils and Fats Industries and opposed by dairy and cottonseed oil interests. G. H. Rasch, for the National Stearic Acid Association, asked for protection against dumping of stearic acid by the Dutch.

Improvements in Chemical Engineering Courses

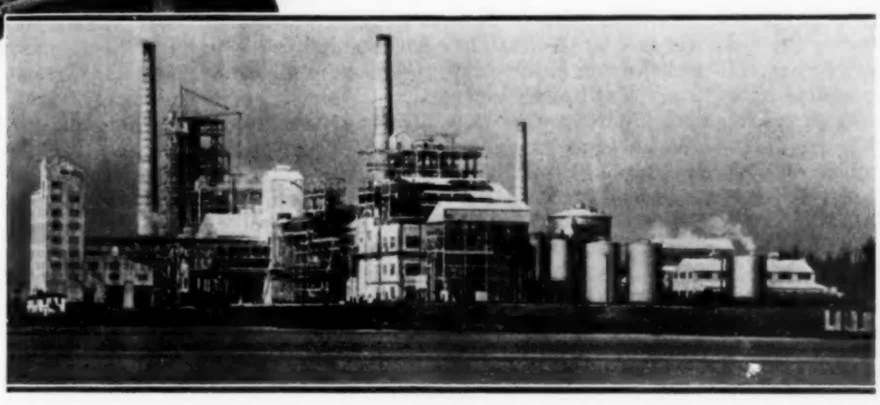
REORGANIZATION of the curriculum in chemical engineering at Washington University, following the standards set by the American Institute of Chemical Engineers, has been announced by Dean Alexander F. Langsdorf of the School of Engineering and Dr. LeRoy McMaster of the Department of Chemistry. Dr. Lawrence E. Stout of the latter department has been appointed Associate Professor of Chemical Engineering. The division of chemical engineering, offering the degree of B.S., was established in 1901. Since that time 250 students have received the B.S. and 69 the M.S. Four Ph.D. degrees have been conferred, three of which went to graduates of Washington in chemical engineering.

Adoption of a common curriculum for all Freshmen engineers of Purdue University, which will make the first engineering year an orientation period and enable a student by study and experience to decide intelligently upon the particular course of engineering which he desires to study, was announced Feb. 1 by Dean A. A. Potter of the School of Engineering, following approval of the faculty. The new common curriculum will go into effect with the opening of the academic year next Fall. Dean Potter pointed out that this action conforms to the recommendation of the Society for the Promotion of Engineering Education and the practices of a number of prominent engineering schools.

Speaking recently before an alumni group in New York, President A. C. Willard of the University of Illinois, declared that undergraduate curricula, especially in the first two years, should be liberalized to avoid the present overspecialization. This is essential, he said, largely because from 20 to 50 per cent of the students in colleges and universities are dropped or leave school by the end of two years and they feel they have learned little that will be of later use to them. President Willard is a graduate chemical engineer.



New Alkali Plant of Mathieson Alkali Works at Lake Charles, La., now in operation



Regular shipments of alkali began on Feb. 1 following weeks of experimental operation. Right is photographic view of plant and above is aerial view

New Products From Acetylene and Ethylene in Germany

UNUSUAL promise appears to be offered in the new field of synthetic products recently opened through the production of highly polymerized compounds from acetylene and ethylene. According to a report by G. Kranzlein the new products are made partly over very complicated and reactive compounds by new polymerization methods which do not involve simple condensations but chain reactions. Thus I. G. Farbenindustrie and Consortorium f. elektrochemische Industrie have produced Movrilithe and Vinnapase, clear polymerization products fast to light, for the lacquer industry, for non-breakable glass and other uses. New fields of application may be found for the derivative polyvinyl alcohols as water soluble rayon sizes. The aldehyde condensation products have value as non-ageing gutta-percha and balata substitutes. Polystyrol, a clear colorless product, fast to light, which can be sprayed, is available for electrical purposes, in radio technique and related uses. Absolutely new polymerization products, fast to light, without smell, and non-inflammable, with properties superior to those of celluloid, have recently been put on the market.

A new process for production of iron from the low-grade German ores from the Harz district, averaging about 30 per cent iron, has been developed by Dr. Kangro and his associates. It involves extraction with chlorine at 800-1,100 deg. C. As the furnace, which is made of highly refractory material, cannot be heated from the outside the chlorine gas itself must serve as heat carrier, for which purpose it is excellently suited. If the chloridizing is carried out at 1,000 deg. C. the consumption of chlorine is 8 kg. per kg. iron, of which 2 kg. combines with the iron, while the remainder escapes from the furnace with the iron chloride vapor and the liberated oxygen. Before the chlorine gas is admitted to the furnace it is preheated in an electric apparatus with carbon heating elements. Gangue and impurities in the ore are not attacked by the chlorine, and only iron chloride escapes, which is condensed, dissolved in water, and electrolyzed, to produce metallic iron and chlorine which is returned to the extraction furnace. The electrolytic iron is melted down to high-grade electro-steel with addition of suitable alloying constituents. Rapid cooling of the escaping iron chloride vapors is required to prevent the reaction from being reversed. By a special cooling arrangement it is also possible to attain a separation of the 95 per cent chlorine and the 5 per cent oxygen in the waste gases, solid chlorine being produced by cooling in three steps. The economy of the process depends on the cost of electric power; to produce a metric ton of iron 6,700 kw.-hr. and 0.1 — 0.2 ton coal are required. Another method of treating the iron chloride is by reaction with hydrogen, whereby finely divided iron and hydrogen chloride are produced. The latter is decomposed electrolytically into hydrogen and chlorine which are returned to the process.

Two plants for production of gasoline on a semi-technical scale have now been started, the Kogasin plant of Ruhr-Chemie A.G., using the Fischer process (see *Chem. & Met.*, Vol. 41, p. 666) and the I. G. plant at Ludwigshafen, for hydrogenation of coal. According to the inventor the first of these processes starts with a water gas generator, followed first by several washers where the gases are freed from hydrogen sulphide and organic sulphur compounds and then by a contact apparatus equipped with a special oil circulation which serves to keep the contacts at constant temperature. This is followed by an apparatus for removal of the water and for separation of the gasoline from the residual gas. With cobalt contact the following mixture may be produced: Gas oil (boiling point below 30 deg. C.) 4 per cent by weight; gasoline (30-200 deg. C.) 62 per cent; oil (above 200 deg. C.) 23 per cent; solid paraffin from the oil (melting point 50 deg. C.), 7 per cent; hard paraffin from the contact (melting point 70-80 deg. C.) 4 per cent. With 0.5 c.c. per liter tetraethyl lead the gasoline gives a motor fuel with octane number 75. It is a good fuel for airplanes as no solids separate out above—70 deg. C. On account of its aliphatic character the fraction above 200 deg. C., Kogasin II, is a very good diesel fuel; it gives a clear exhaust even with overload, consumption is somewhat smaller than for ordinary gas oil, and it causes no knocking of the motor. Gas oil, Kogasin I, and II contain 50, 30, and 10 per cent by volume olefines, respectively. Excellent lubricating oils may be produced from these fractions by condensation with aluminum chloride or by other methods of synthesis. The higher the olefine content of the original product, the better the qualities of the lubricating oils; the original olefine content may also be increased by proper selection of catalysts (with water gas cobalt gives 55 per cent by volume olefines, with nickel only 35 per cent.). A lubricating oil from the Kogasin fraction 150-200 deg. C. showed the following properties: Specific gravity, 0.836 at 20 deg. C.; Engler viscosity at 20 deg. C., 19.4, at 50 deg. C., 4.0; Conradson carbon 0.02; pour point—33 deg. C. Kogasin lubricating oils have no characteristic color; it is quite possible to obtain a completely colorless oil by hydrogenation of oils free from sulphur at low temperature, using a nickel catalyst. The principal economic justification for the process is the large quantity of coke in Germany difficult to market, a result of the country's high gas consumption. It cannot be produced at as low a cost as duty-free and tax-free American gasoline, but Ruhr-Chemie hopes to be able to find a market with the protection afforded by the present duty and tax policy.

According to a report by M. Pier on the I. G. process for direct hydrogenation of coal a total of 1,500 tons was treated in the test plant. In November, 1934, 20 tons was treated daily, from which 13 to 14 tons of oil was obtained. About 20 per cent of the volatilized products, corresponding to 14 per cent of the carbon content, is obtained in the form of gas, of which 30 to 40 per cent is propane and butane. The present apparatus has also proved suitable for coal, and the tests showed that the hydrogenation of lignite, which had obtained a lead by long technical development has already been overtaken. The plant costs for coal are lower than for lignite, and with a suitable coal the operating costs are not any higher. The plant produces a very good gasoline for motor cars and airplanes. The gasoline obtained from the coal furnace, unlike that from the lignite furnace, may be refined directly, yielding phenols, for instance carbolic acid. With coal the products obtained are generally of lower hydrogen content than with lignite; according to Pier the direct hydrogenation of coal is the process to use for producing motor fuel, where byproducts difficult to market are not desired, and it is also preferable to hydrogenation of tar.

The December meeting of the Society for Motor Fuel and the German Society for Mineral Oil Research was devoted to the subject: "Gas in German Commerce and Transportation." Of interest is the possible German production of liquefied propane and butane from natural gas, and from gases in hydrogenation plants and coke ovens. The German postal department has already converted many buses for operation with gas; 1 kg. liquefied gas has been

found equivalent to 1.7 liter gasoline-benzol mixture. A bus equipped with four flasks, each containing 22 kg. gas (weight of empty flasks 32 kg., operating pressure 12 atm.) has a cruising range of about 400 km. Ruhr gas oil is a liquefied gas consisting of about 54 per cent propylene and butylene, 17 per cent propane and butane, 15 per cent ethylene, and some methane and ethane. About 2,000 tons is produced annually in the Ruhr district. It is made from coke oven gas by cooling to low temperature or by direct treatment with activated carbon. By removal of the oil the gas is also freed from naphthalene and other easily condensed impurities, whereby it becomes a better city gas. The gas oil flasks used weighing 55 kg. empty, contain 45 kg. or 64 liters of gas oil. According to Fr. Schuster non-poisonous city gas may be produced by oxidation of the carbon monoxide by means of iron contacts at 350-400 deg. C.

Procter & Gamble Acquires Foreign Soap Plants

FURTHER extension of its business in foreign countries is indicated in an announcement that Procter & Gamble has purchased the business and properties of the Philippine Manufacturing Co., Manila, P. I. The company is reputed to be the largest manufacturer of soap in the islands. The announcement followed closely on a report that Procter & Gamble had acquired the business and properties of J. Barcelou & Cie., Ltd., of Montreal, Quebec, one of the important independent soap manufacturers in Canada. The purchase was for cash, but the amount was not revealed.

The Barcelou company was established in 1865 and is one of the oldest soap factories in Canada, manufacturing several brands of toilet and laundry soap and allied products. Its business is concentrated almost wholly in the province of Quebec. It is the fourth largest soap manufacturing company in Canada.

Italian Company Extracts Potash From Sea Brine

IN a report from Trade Commissioner Elizabeth Humes it is stated that Soc. Italiano Potassio Marino has developed, with assistance of the Italian Government, the so-called Niccoli process of extracting potash salts from concentrated sea brine. It is operated on a commercial scale at Massaua on the Red Sea in conjunction with the Erythrean salt works, and experimentally near Naples. Starting with a brine solution from salt pans, a concentrated brine is obtained by solar evaporation. This, it is alleged, can be processed to yield kainite or potassium-magnesium sulphate, with sodium chloride and magnesium chloride as coproducts.

Electrochemists Will Meet in New Orleans in March

NOT SO many years ago the important industrial centers in the United States were practically all located in the northern states. Due to a number of causes, among which we cannot overlook climate, labor, cheap transportation all year round, and ready access to extensive deposits of various raw materials, industrialists have turned their attention southward. One of the latest chemical centers now rapidly developing in the South is that of New Orleans. Within the last few years a number of industries have firmly established themselves in the New Orleans District: alkalichlorine, petroleum products, celotex, and a long list of special chemicals.

It is on these accounts that New Orleans was selected as the convention city for the Spring Meeting of The Electrochemical Society, and members and guests will be afforded ample opportunity to investigate and fully appreciate the bases for New Orleans' claim to supremacy.

However, New Orleans attracts the visitor not only through its industrial advantages, but as a historical town. With its many fascinating French, Spanish and Creole characteristics, it will appeal to many northern members and guests.

The Hotel Roosevelt has been selected as headquarters for the meeting and registration will begin on Wednesday evening, March 20. The program for March 21 includes a group breakfast, a scientific-technical session, luncheon at the Patio Royale, an address by Dr. R. A. Steinmayer of Tulane University on "Salt Domes—The Impetus to Geophysical Prospecting," a second technical session, meeting of the board of directors, and an informal dinner and dance at the Louisian.

On March 22 an all-day trip is scheduled to the Freeport Sulphur's plant at Grand Ecaille—ladies included. After luncheon at the plant, Dr. Ralph L. Miller, entomologist for the company, will speak on "Sulphur in Agriculture." In the evening, at New Orleans, a joint meeting will be held with the Louisiana Engineering Society, the American Chemical Society, and the American Institute of Chemical Engineers. An address will be given by George Earl on the drainage problems of New Orleans.

On Saturday, March 23, the meeting will close with a technical session in the morning followed by plant visits in the afternoon to American Sugar Refinery, Celotex plant, and a harbor trip.

The following manuscripts have been accepted by the publication committee and distributed to members: About 20 others are now in the hands of the publication committee. These latter cover a wide diversity of topics including decomposition potentials, fused electrolytes, electrodeposition of cadmium-zinc alloys, zinc, brass, copper-nickel-zinc alloys, asbestos diaphragms, etc.

Preprint *67:1*—"Voltaic Couples and Corrosion," by Oliver P. Watts of the University of Wisconsin.

Preprint *67:2*—"Electrolytic Reduction of Ketones. II. Reduction of Aliphatic Ketones to Hydrocarbons," by Sherlock Swann Jr. and Jack Feldman of the University of Illinois.

Preprint *67:3*—"Motor Electrolytic Current as a Factor in Corrosion," by E. Newbery of the University of Cape Town, South Africa.

Preprint *67:4*—"Solution Rates of Zinc Electrodes in Acid Solutions," by H. Mouquin and W. A. Steitz of Washington Square College, New York University.

Preprint *67:5*—"Hydrogen Overvoltage and the Anodic Behavior of Tungsten in Aqueous Solutions of Potassium Hydrate," by M. deKay Thompson and C. W. Rice Jr., of Massachusetts Institute of Technology.

Preprint *67:6*—"Electrolytic Reduction of Ketones. III. Reduction of Mixed Ketones," by Sherlock Swann Jr. and G. H. Nelson of the University of Illinois.

Preprint *67:7*—"Determination of Trivalent Chromium in Chromic Acid and in Chromium Plating Baths," by H. H. Willard and Philena Young of the University of Michigan.

Preprint *67:8*—"Studies in Zinc Electrodeposition: Deposition From Ammonium-Sulfate-Zinc Baths," by R. R. Rogers and Edgar Bloom Jr. of Columbia University (New York City).

Preprint *67:9*—"The pH Values of Solutions of Boric Acid, Disodium Phosphate and Sodium Bicarbonate, etc. Parts I-IV," by S. J. Kiehl and R. D. Loucks of Columbia University (New York City).

Preprint *67:10*—"Use of the Haring Cell in Detecting Electrode Reactions," by J. E. Stareck and Robert Taft of the University of Kansas.

Preprint *67:11*—"Reversible Rectification in Electrolytic Rectifiers," by E. W. Chambers of the University of Melbourne, Australia.

Preprint *67:12*—"A Further Study of Cyanide Zinc Plating Baths Using Al-Hg—Zn Anodes," by A. K. Graham of the University of Pennsylvania.

NAMES *in the News*

ARTHUR D. LITTLE has retired as president and has been elected chairman of the board of directors of Arthur D. Little, Inc. Earl P. Stevenson, who has been with the organization since 1919 and vice-president since 1922, has been elected president. Roger C. Griffin has been elected treasurer. Dr. Little became chairman of the Cambridge scientific organization within a year of its fiftieth anniversary.

LAWRENCE W. WALLACE, known to chemical engineers principally for his service as executive secretary of American Engineering Council, has been named as the director of equipment research of the Association of American Railroads.

JULIUS A. NIEUWLAND, professor of organic chemistry at the University of Notre Dame, has been awarded the gold medal of the American Institute. The award was made for the discovery of a process for making synthetic rubber. Professor Nieuwland has also been awarded the William H. Nichols Medal of the New York Section of the American Chemical Society.

JAMES A. TAYLOR recently joined the staff of Pennsylvania State College as research assistant in fuel technology. Dr. Taylor, after receiving his Ph.D. degree from the University of Washington, for two and a half years was assistant chemical engineer in the Northwestern Experimental Station of the Bureau of Mines at Seattle.

I. E. MUSKAT has accepted an appointment with the Gulf Oil Co. Dr. Muskat will be located at Pittsburgh.

G. H. STILLMAN, formerly with the Girdler Corp., Louisville, Ky., is now with the Gulf Oil Co. at Pittsburgh.

AUSTIN M. PATTERSON, head of the department of Chemistry and vice-president of Antioch College, has been appointed by President Parravano of the International Union of Chemistry, to the newly constituted international committee on organic chemical nomenclature.

YALE W. TITTERINGTON, who recently graduated from the University of Nebraska, is now employed by the Standard Oil Co. at Midwest, Wyo.

Edward Bartow

EDWARD BARTOW, head of the department of chemistry and chemical engineering in the State University of Iowa, has been elected president of the American Chemical Society for 1936.

E. H. STEVENSON, who graduated from the University of Illinois in June, has joined the analytical staff of Armour & Co.

DAVID W. WATKINS, for 16 years assistant director, has been appointed director of the Extension Service of South Carolina to succeed the late Dr. W. W. Long, according to an announcement of Dr. E. W. Sikes, president of Clemson College. Mr. Watkins was born in Anderson County, S. C., and is a graduate of Clemson in the class of 1909.

D. F. JURGENSON, JR., has been appointed chemist in the research and development laboratory of the Pure Oil Co. He will be stationed at Winnetka, Ill.

ALFRED E. RHEINECK, formerly an instructor in the extension division of the University of Wisconsin, is now associated with Devoe & Raynolds, at Louisville, as assistant director of research.

IRVIN LAVINE, professor of chemical engineering at the University of North Dakota, has been appointed by the National Resources Board to the position of consultant to the North Dakota State Planning Board. The University has extended him a leave of absence for the period of his appointment. His headquarters will be at the University.

JOHN P. HARRIS has joined the Wilson & Bennett Manufacturing Co. Mr. Harris' activities will embody complete supervision of the development, production and sales of containers for edible products. For about 8 years he has been Chicago manager for the Industrial Chemical Sales Co.

MARK PLUNGNIAN has accepted a position in the research laboratory of Thomas & Hochwalt Laboratories, Dayton, Ohio. Dr. Plungnian will be in charge of research work on lignin and paper chemistry. He was the first graduate student in the Idaho School of Forestry's newly established wood chemistry laboratory.

KENNETH H. HOOVER has resigned his position in the Minor Laboratories in order to accept the position of manager at the Terre Haute plant of the Indiana Wood Preserving Co.

FRED L. HUMOLLER, who recently received his Ph. D. degree from the University of Chicago, has joined the research staff of the Minor Laboratories.

FLOYD A. VAN ATTA has joined the staff of Armour Institute of Technology as instructor in chemistry.

ROBERT E. WILSON, vice-president in charge of research and development of the Standard Oil Co. of Indiana, has been transferred to New York to assume the position of vice-chairman of the board of the Pan-American Petroleum and Transport Co. Before leaving Chicago Dr. Wilson's friends gave a dinner in his honor.

BRUCE K. BROWN, who has been manager of the development and patent department of the Standard Oil Co. of Indiana, will continue in that capacity, but will assume some of the duties previously performed by Dr. Wilson.

F. W. SULLIVAN, JR., who has been director of research at Whiting, has been made general research director of the company. He will henceforth be located in Chicago and will take over the research duties formerly handled by Dr. Wilson.

W. HERBERT BAHLKE succeeds Dr. Sullivan as director of research at the Whiting refinery. Dr. Bahlke joined the company in 1921 and has been assistant director of research. Ernest W. Thiele succeeds to Dr. Bahlke's position of assistant director.

WILLIAM B. PLUMMER, who came to the oil company in 1921 from Massachusetts Institute of Technology, has been made assistant manager in charge of development under Mr. Brown.

H. J. WEILAND, director of the Carrollville laboratory of E. I. duPont de Nemours & Co., has been transferred to the Jackson Laboratory of the company. He has been associated with the Carrollville organization since his graduation from the University of Illinois in 1917.

J. W. COPENHAGEN, who recently received his Ph.D. degree in the organic chemical department at the University of Illinois, is now associated with Socony-Vacuum Oil Co. at Paulsboro, N. J.

A. E. CALKINS is located at Akron, Ohio, where he is employed by the Goodrich Rubber Co.

F. W. KLAYER has joined the technical staff of the Hiram Walker Distillery Co. He is located at the company's new plant at Peoria, Ill.

E. J. KRAETCH is now with the Commercial Testing and Engineering Co., Chicago, Ill.

W. J. BRAY has transferred from the University of Missouri to the chemical department at Iowa State College.

H. D. KASLOW of North Dakota State College has transferred to the chemical section of the Agricultural Experimental Station, Ames, Iowa.

EDWIN SUTERMEISTER, chief chemist of S. D. Warren Co., Cumberland Mills, Me., is the recipient of the T.A.P.P.I. medal for 1935. Mr. Sutermeister was born in Milton, Mass., and was graduated from M. I. T. in 1899. He was employed as a chemist in the U. S. Forest Service from 1907 to 1910. With the exception of these years he has been with the Warren company since 1898.

STEPHEN TYLER of Thermal Syndicate, Ltd. has been elected chairman of the New York Section of the American Institute of Chemical Engineers. The other officers are: John P. Hubbell, vice-chairman, and Leslie C. Hughes, secretary-treasurer. Lincoln T. Work and P. E. Landolt were elected members of the board.

L'ROCHE GEORGE BOUSQUET, formerly chemical engineer with the Titanium Pigment Co. at St. Louis, has been with the American Zirconium Corp. at St. Helena, Md., for the past year in the capacity of technical director.

CHARLES A. KRAUS, professor of chemistry at Brown University has been awarded the 1935 Willard Gibbs Medal of the Chicago section of the American Chemical Society.

E. B. BESSELIEVRE of the Dorr Co. sailed for South America in January to be gone for a year. He will visit most of the South American nations in connection with sanitary work.

CHARLES L. GULICK has been elected president of the Compressed Gas Manufacturers' Association. Other officers are: Dr. W. P. Heath, W. P. Uhler and F. R. Fetherston.

FRED J. WALL has joined the development and research department of the International Nickel Co. For 18 years Mr. Wall was metallurgist at the Wilson Foundry & Machine Co., Pontiac, Mich.

N. K. CHANEY has left the National Carbon Co. to join the United Gas Improvement Co. where he will be assistant director of research. He was a member of the research staff of National Carbon since 1911.

CALENDAR

ELECTROCHEMICAL SOCIETY, annual meeting, New Orleans, Mar. 21-23.

AMERICAN CHEMICAL SOCIETY, New York, week of Apr. 22.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Wilmington, Del., May 14-16.

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, annual meeting, Denver, June 4.

CANADIAN CHEMICAL ASSOCIATION, annual meeting, Kingston, June 4-6.

AMERICAN ELECTRO-PLATERS' SOCIETY, annual meeting, Bridgeport, Conn., June 10-14.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Detroit, June 24-28.

EXPOSITION OF CHEMICAL INDUSTRIES, New York, week of Dec. 2-7.

OBITUARY

ARTHUR P. BRYANT, vice-president of the Clinton Co., and president of the Clinton National Bank, died at his home at Clinton, Iowa, February 3. He was 67 years old and an authority in the corn processing industry. His chemical discoveries and research with starch were internationally known.

JOHN T. BAKER, chairman of the board of the chemical company of that name, died January 17 at Lake Wales, Fla. He was stricken while playing golf near his winter home. Mr. Baker was 74 years of age.

While still a student at Lafayette College with the support of his chemistry professor, Dr. Edward Hart, he founded the industry with which his name has been associated. In 1885 the two partners were joined by George P. Adamson and the association continued until the business was absorbed by General Chemical Co. In 1904, Mr. Baker set out independently and founded the firm of J. T. Baker Chemical Co.

JOHN A. MATHEWS, vice-president and director of research for the Crucible Steel Co. of America, died at his home at Scarsdale, N. Y., of heart trouble on January 12. He was 62 years of age. After graduating from Washington & Jefferson College and Columbia University, Dr. Mathews joined the steel company. He had served as president of the Halcomb Steel Co., the Syracuse Steel Co. and the Crucible organization. But he retired from the presidency of the last in 1924 to devote his efforts to research.

FREDERICK B. KILMER, director of the scientific laboratories of Johnson & Johnson, died December 28. He was 83 years of age. Mr. Kilmer joined the firm in 1899 after graduating from Columbia, Yale and Rutgers universities.

GEORGE KEVILLE DAVIS, who since the death—27 years ago—of his father, the founder of the *Chemical Trade Journal and Chemical Engineer*, has guided its fortunes, died December 9 at the early age of 56.

DAVID REES BOMEN, for 45 years chief engineer and vice-president of Farrel-Birmingham Co., died at his home at Ansonia, Conn., on December 29.

GEORGE H. NASH, formerly general manager of the manufacturing department, Virginia-Carolina Chemical Corp., died January 3, at Richmond. He had been ill for several months. During Mr. Nash's illness his duties were handled by Edward Ryland, who succeeds Mr. Nash as general manager in charge of the department.

HARRY DRAKE GIBBS, formerly chief of the color laboratory of the Bureau of Chemistry, died in Washington on December 27, after a brief illness, at the age of 62. Dr. Gibbs, for many years an investigator in the field of dyes and organic chemicals, was responsible for the development of a number of new products which became industrialized during and immediately following the War. He later was associated with the research staff of the duPont company, and more recently was in charge of the chemical division of the Hygienic Laboratory of the U. S. Public Health Service. Since 1929, when he retired from the Government work, he has been engaged in consulting chemical engineering, with special reference to synthetic organics.

Chemical ECONOMICS

UNEXPECTEDLY sharp increases in manufacturing activities on the part of some large industries in the closing weeks of last year carried general industry into the new year on a scale considerably higher than had been the case a year ago. For last December the Federal Reserve Board reported one of the sharpest upturns in business activity since 1929. Output of basic industrial products was shown to have increased in December, when it usually declines. The board's index rose from 74 per cent of the 1923-'25 average in November to 85 per cent in December.

"Activity at steel mills increased, contrary to the usual seasonal tendency, and output at automobile factories rose rapidly," the summary continued. "In both of these industries there were further sharp increases in activity in the first three weeks of January. At woolen mills and silk mills activity increased in December, contrary to seasonal tendency, and at cotton mills and tobacco factories it declined by less than the usual seasonal amount. Output of petroleum increased somewhat in December and the first half of January.

"Factory employment increased between the middle of November and the middle of December, contrary to seasonal tendency, and there was a considerable growth in factory pay rolls. Substantial increases were reported for the automobile, textile, shoe and tire industries, while in the meat-packing industry there was a further decline from recent high levels."

In its January issue *Chem. & Met.* estimated production of rayon in 1934 at a figure slightly below the 1933 production total. This estimate is now subject to revision due to the large output in December. Figures of rayon production as compiled by *Textile Organon* placed the 1934 output at 210,331,000 lb., which established a new record, the total being nearly 1 per cent larger than that for the preceding year.

Production of rayon since the turn of the year has proceeded at a capacity rate and a rather high manufacturing rate has been maintained generally throughout the textile industry. Consumption of cotton at domestic mills was reported to have run considerably above 500,000 bales and to have been the highest for any January since 1930.

Because of the variety of chemicals, varnish, and lacquer materials involved, the status of the automotive industry is of special interest. Judging from present reports there is good reason to believe that the total number of units produced in the first quarter of this year will approximate 1,000,000. In other words, consumption of raw materials in the automotive trade promises to be about one-third higher in the first quarter of this year than it was in the corresponding period of last year. Such a production schedule undoubtedly will build up dealer stocks with later developments depending on consumer sales.

Higher Chemical Production

Trade reports relative to the rate of chemical production coincide rather closely with the report of the Atlantic States Shippers Advisory Board which estimates the car requirements for moving chemicals and explosives in the first quarter of this year at an increase of 10.9 per cent over the like period of 1934.

On a similar comparison, car requirements for cement are placed at an increase of 14 per cent; brick and clay products at 5.2 per cent; lime and plaster, 6.7 per cent; automobiles and parts, 13 per cent; fertilizer, 17.5 per cent; paper, paper board, and prepared roofing, 5 per cent. On the other hand, decreases are estimated in the case of coal and coke, 6.4 per cent; salt, 6.2 per cent; and petroleum and products, 5 per cent.

Tanning Materials Outlook

The outlook for consumption of tanning materials has given rise to considerable apprehension because of the large stocks of hides which, it was feared might demoralize the industry by causing a material decline in prices. However, the storage of 3 to 4 million cattle hides, including calf skins, accumulated by the Federal Surplus Relief Corp. as a result of the drought cattle program, does not constitute a threat to the hide market according to present expectations. The plan is to feed them into the market gradually. The FSRC has announced contracts to store approximately 8.5 million pounds of cured hides. Inasmuch as the carryover of stocks for shoes was less at the end of 1934 than for the year preceding and because the kill this year is bound to be light, hide prices are expected to advance through the year, requiring some exports. A change in the 10 per cent tariff on hides is thought unlikely under reciprocal trading agreements but a cut to 5 per cent would not materially affect the situation. The demand for leather substitutes may be expected to show an upward trend.

Labor troubles have figured in the glass trade but have been settled and production in recent weeks has been increasing with outputs in excess of those of a year ago and with indications that these conditions will continue through at least the first quarter of the year.

Fertilizer production of sulphuric acid last year was 1,519,504 tons.

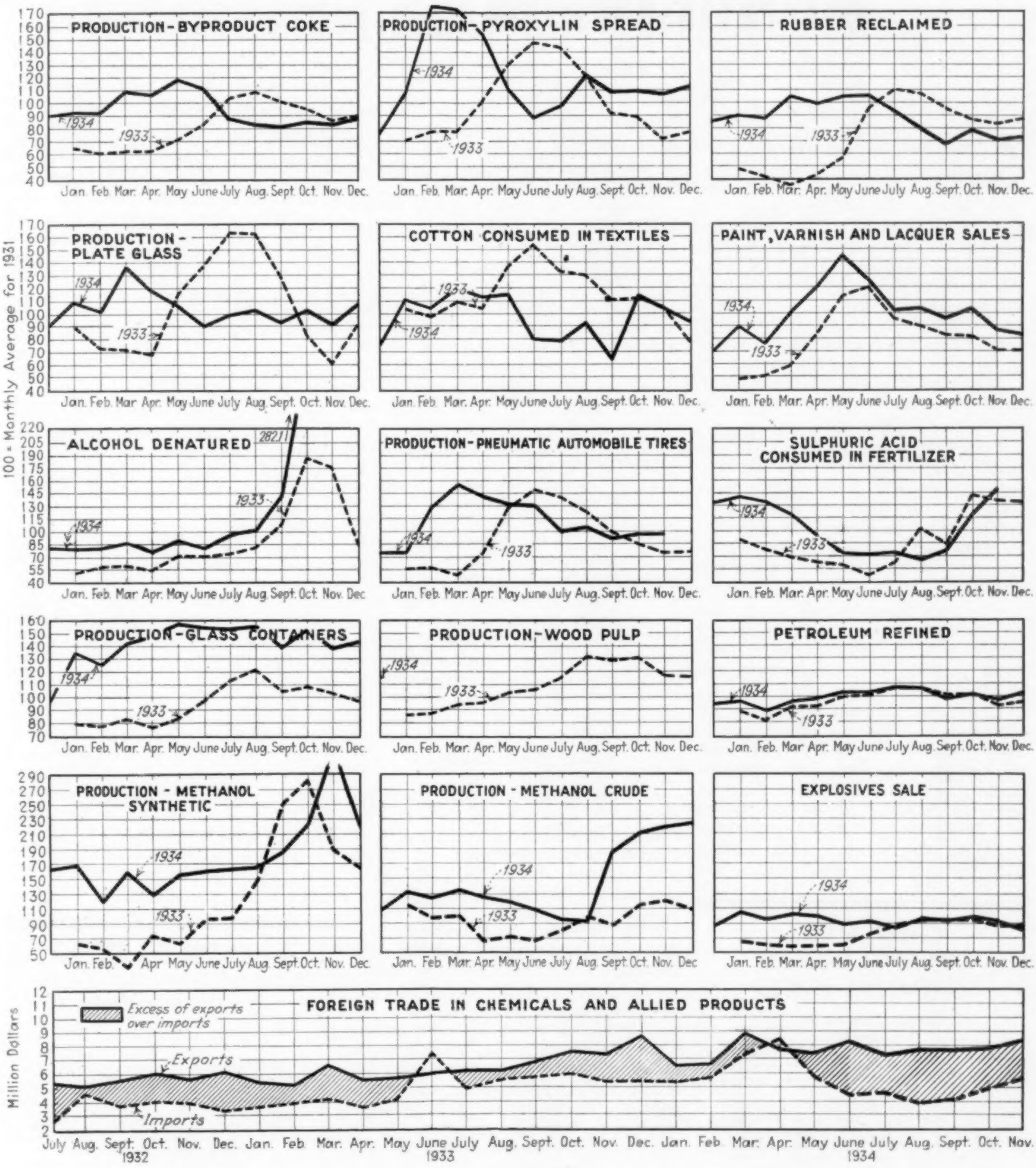
The accompanying table gives data for production of some chemicals and data which give a basis for judging the relative position of the important chemical-consuming industries in 1934 as compared with the preceding year.

Production and Consumption Data for Chemical-Consuming Industries

Production	Dec., 1934	Dec., 1933	Jan.-Dec., 1934	Jan.-Dec., 1933	Per Cent of Gain in 1934
Byproduct coke, 1000 tons	2,418	2,451	30,833	26,711	15.4
Glass containers, 1000 gr.	2,922	1,997	35,799	23,522	52.2
Plate glass, 1000 sq.ft.	7,922	6,347	91,340	86,039	6.1
Methanol, crude, gal.	319,190	300,303	3,726,230	3,031,924	22.9
Methanol, synthetic, gal.	1,301,841	962,185	12,534,424	8,793,152	42.5
Petroleum, refined, 1000 bbl.	75,976	70,440	893,302	861,254	3.7
Pyroxylin spread, 1000 lb.	3,337	2,351	44,337	36,242	22.3
Rubber reclaimed, tons	7,353	8,966	108,159	93,586	15.5
Cottonseed oil, crude, 1000 lb.	478,280†	519,590†	1,223,529	1,399,655	12.9*
Cottonseed oil, refined, 1000 lb.	434,517†	430,691†	1,192,580	1,234,369	11.5*
Castor oil, 1000 lb.	10,542†	11,069†	42,376	44,847	5.5*
Linseed oil, 1000 lb.	90,253†	133,906†	370,769	405,948	8.6*
Steel barrels, no.	422,985	610,440	6,677,322	6,571,581	1.6
Consumption					
Cotton, 1000 bales	414	348	5,413	6,210	12.8*
Explosives, sales, 1000 lb.	22,635	23,318	307,385	249,386	23.2
Paint, varnish and lacquer sales, $1000	16,515	16,156	282,463	222,761	26.8
Linseed oil, factory, 1000 lb.	54,338†	55,783†	257,457	241,325	6.7
China wood oil, 1000 lb.	24,388†	22,228†	105,277	91,549	15.0

*Per cent of decline. †Quarter ended Dec. 31.

TRENDS OF PRODUCTION AND CONSUMPTION



The MARKETS

STARTING around the middle of last December, there was a noticeable pick-up in some of the industries which are quantity buyers of chemicals. As a result, the movement of chemicals into consuming channels in January was larger than in the opening month of 1934. A still more active call for deliveries has been experienced in the present month to date. A good part of the improvement can be traced to improved buying on the part of the metallurgical trades with active conditions also reported in rayon, textile, fertilizer, and glass circles.

Prices for a few chemicals are distinctly competitive but the vast majority of chemicals present a firm price tone and the trend, if anything, is upward although the bulk of deliveries is against contract on which no price changes are in prospect for some months.

Prices for vegetable oils and animal fats, however, continue on an upward course and the all-commodity price trend recently has been upward and this tends to have some effect on values for chemicals. In some cases prices for chemicals have been influenced by production as may be typified in the case of lead oxides which have followed declines in the metal. One of the most important changes in the last month was found in a sharp drop in quotations for zinc oxide. This resulted partly from a lower metal market and partly from selling pressure on the part of producers. On the other hand price lists for some of the higher alcohols were revised upwards and the solvent and acid markets were less subject to selling pressure.

Fertilizer manufacturers were interested in an announcement made on Feb. 5 to the effect that fertilizer mixtures on hand prior to the establishment of standard grades may hereafter be sold even though such mixtures do not conform to the approved grades. The Fertilizer Recovery Committee (Code Authority) requested the stay. The fertilizer code provides for the establishment of fertilizer grades suitable to meet the agricultural needs of various sections. After approval of lists of grades the sale of mixed fertilizer not conforming to the approved standards in the respective sections is prohibited except to fill special orders. The order requires industry members to file with the Fertilizer Committee before February 24, or within 10 days after the approval of grades in areas where mixtures have not already been approved, a statement indicating the amount of off-grades on hand.

Foreign Cartels Continued

Foreign developments of importance as reported from our consular office included a report from London that in its 1933-34 annual review of the world nitrogen trade the British Sulphate of Ammonia Federation stated that the agreements of the federation (representing byproduct and synthetic producers of Great Britain) with the most important Continental producers had a steadying effect on the market and resulted in members of the federation receiving higher prices for their output than in 1932-33. The absence of a definite agreement with the Chilean interests led to price-cutting in certain markets. Prospects for 1934-35 were considered brighter, agreements with the Continental producers having been renewed, arrangements were reached with the Japanese producers of ammonium sulphate and a definite agreement was made with the Chilean nitrate industry. These arrangements, it is reported, should provide a more stable price structure.

A report from Frankfort-on-Main says that four important German syndicates regulating the sale of potash byproducts, namely, German Magnesium Chloride Syndicate, German Bromine Syndicate, German Bitter Salts Syndicate, and German Bromine Salts Syndicate, all scheduled to expire at the end of 1934, were extended for a further period running, with the exception of the Bromine Salts Syndicate, to December 31, 1943. In the event that the first three of the syndicates mentioned are not canceled by any of the member companies not later than one year prior to Dec. 31, 1943, they automatically become prolonged for a still further term of 10 years. Extension of the Bromine Salts Syndicate has been limited to only one year, or to Dec. 31, 1935, because of uncertainties in the bromine export trade. If not canceled not later than three months before the new expiration date, this syndicate will automatically be extended for a further one-year term.

It also is added that negotiations initiated last spring between Saar and German benzol producers have terminated in an agreement whereby two leading Saar benzol producers will become members of the German Benzol Association.

Imports of Iodine

The organization which is now handling the sale of Chilean iodine has announced that "The policy followed by the Corporation for sales of iodine, has been to establish free sale and competitive prices in all markets. With this end in view the special contracts which existed have been terminated, only those which did not impede the application of these principles being maintained." Incidentally imports of iodine last year amounted to 1,471,207 lb. valued at $2,118,676 as compared with 1,411,687 lb. valued at $2,936,489 for 1933. All of the 1934 receipts came from Chile except 2,100 lb. credited to Japan.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**87.60**
Last month	87.53
February, 1934	88.37
February, 1933	84.54

Lower prices were in effect on zinc oxide and on a few miscellaneous chemicals but the list in general was firm with higher prices for some of the alcohols and for spirits of turpentine. Net changes brought a slight advance in the index number.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	90.94
Last month	86.64
February, 1934	54.32
February, 1933	41.70

With scarcely an exception, higher prices were reached in the market for vegetable oils and animal fats. Crude cottonseed oil sold as high as 10c. a lb. A new high for the season also was reported for tallow.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Feb. 14.

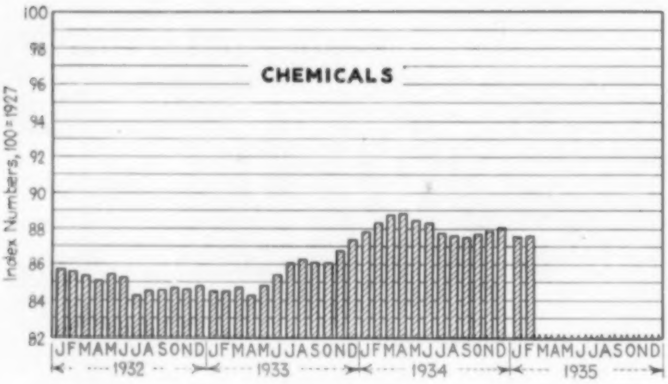
Industrial Chemicals

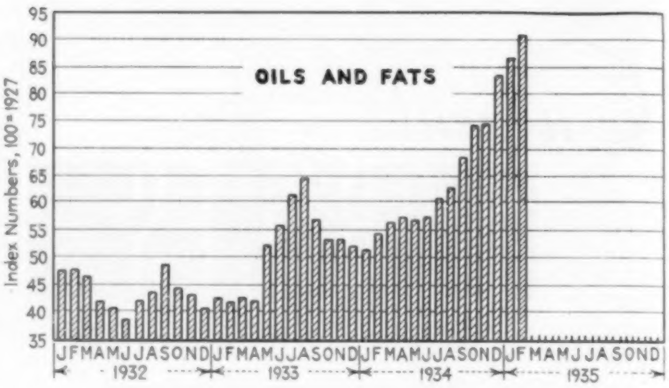
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.12 -$0.12½	$0.12 -$0.12½	$0.11 -$0.11½
Acid, acetic, 28%, bbl., cwt.	2.40 - 2.65	2.40 - 2.65	2.90 - 3.15
Glacial 99%, drums	8.25 - 8.50	8.25 - 8.50	10.02 -10.27
U. S. P. reagent, c'bys	10.52 -10.77	10.52 -10.77	10.52 -10.77
Boric, bbl., lb.	.04¾- .05	.04¾- .05	.04¾- .05
Citric, kegs, lb.	.28 - .31	.28 - .31	.28 - .31
Formic, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .11½
Gallic, tech., bbl., lb.	.60 - .65	.60 - .65	.60 - .65
Hydrofluoric 30% carb., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Latic, 44%, tech., light, bbl., lb.	.12 - .12½	.12 - .12½	.11½- .12
22%, tech., light, bbl., lb.	.06½- .07	.06½- .07	.05½- .06
Muriatic, 18° tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton.	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11¼- .12⅛	.11¼- .12⅛	.11¼- .12⅛
Phosphoric, tech., c'bys., lb.	.09 - .10	.09 - .10	.09 - .10
Sulphuric, 60°, tanks, ton.	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton.	15.50 -......	15.50 -......	15.50 -......
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.24 - .25	.24 - .25	.25½- .26
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol Amyl	......-......	......-......	......-......
From Pentane, tanks, lb.	.143-......	.143-......	.15 -......
Alcohol Butyl, tanks, lb.	.12 -......	.12 -......	.095-......
Alcohol, Ethyl, 190 p'f., bbl., gal	4.15½-......	4.15½-......	4.15½-......
Denatured, 190 proof			
No. 1 special, dr., gal.	.346-......	.346-......	.346-......
No. 5, 188 proof, dr., gal.	.34 -......	.34 -......	.34 -......
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com., bags, cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .16	.15½- .16	.15¼- .15½
tanks, lb.	.04½-......	.04½-......	.05 -......
Ammonium carbonate, powd. tech., casks, lb.	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt.	1.20 -......	1.20 -......	.125-......
Amylacetate tech., tanks, lb.	.142-......	.142-......	.145-......
Antimony Oxide, bbl., lb.	.10½- .10¾	.10½- .10¾	.08½- .10
Arsenic, white, powd., bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Red, powd., kegs, lb.	.15¾- .16	.15¾- .16	.14 - .15
Barium carbonate, bbl., ton.	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton.	74.00 -75.00	74.00 -75.00	61.50 -63.50
Nitrate, cask, lb.	.08½- .09	.08½- .09	.08½- .09
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.90 - 2.00	1.90 - 2.00	1.85 - 2.00
Borax, grain, bags, ton.	40.00 -45.00	40.00 -45.00	40.00 -45.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags.	2.00 -......	2.00 -......	3.00 -......
Arsenate, dr., lb.	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	17.50 -......	17.50 -......	17.50 -......
flake, dr., wks., ton.	19.50 -......	19.50 -......	19.50 -......
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05½- .08½	.05½- .06	.05½- .06
Tetrachloride drums, lb.	.05½- .08½	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb.	2.00 -......	2.00 -......	.0185-......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb.	1.25 - 1.3	1.25 - 1.30	1.35 - 1.40

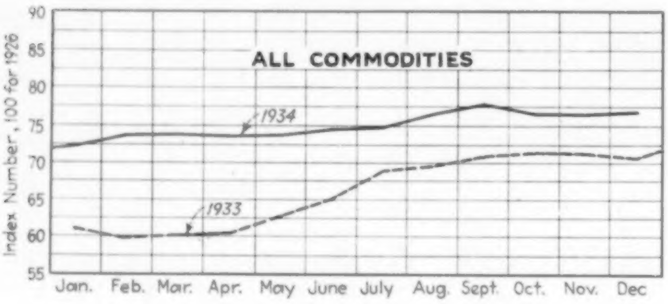
	Current Price	Last Month	Last Year
Copperas, bgs., f.o.b. wks., ton.	14.00 -15.00	14.00 -15.00	14.00 -15.00
Copper carbonate, bbl., lb.	.08¾- .16	.08¾- .16	.08¾- .16
Cyanide, tech., bbl., lb.	.37 - .38	.37 - .38	.39 - .40
Sulphate, bbl., cwt.	3.85 - 4.00	3.85 - 4.00	3.75 - 4.00
Cream of tartar, bbl., lb.	.16¾ .17	.17¾- .18	.18 - .19
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .18
Epsom salt, dom., tech., bbl., cwt.	2.10 - 2.15	2.10 - 2.15	2.10 - 2.15
Imp., tech., bags, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Ethyl acetate, drums, lb.	.08½-......	.08½-......	.08½-......
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	.75 -......	.75 -......	.75 -......
Refined, dr., gal.	1.25 - 1.30	1.25 - 1.30	1.25 - 1.30
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.14 - .14½	.14 - .14½	.11½- .11¾
Lead:			
White, basic carbonate, dry casks, lb.	.06½-......	.06½-......	.06½-......
White, basic sulphate, sck., lb.	.06 -......	.06 -......	.06 -......
Red, dry, sck., lb	.06 -......	.06 -......	.07¾-......
Lead acetate, white crys., bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Lead arsenate, powd., bbl., lb.	.09 - .10	.09 - .10	.10 - .11
Lime, chem., bulk, ton.	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk, lb.	.05 -......	.05¼-......	.06¾-......
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -......	.33 -......	.33 -......
97%, tanks, gal.	.34 -......	.34 -......	.34 -......
Synthetic, tanks, gal.	.35½-......	.35½-......	.35½-......
Nickel salt, double, bbl., lb.	.12½- .13	.12½- .13	.12 - .13
Orange mineral, csk., lb.	.09 -......	.09 -......	.10½-......
Phosphorus, red, cases, lb.	.44 - .45	.44 - .45	.45 - .46
Yellow, cases, lb.	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.07¼- .08½	.07¼- .08½	.07¼- .08½
Carbonate, 80-85%, calc. csk., lb	.07 - .07½	.07 - .07½	.07 - .07½
Chlorate, powd., lb.	.09½- .10	.09½- .10	.09 - .09½
Hydroxide (c'stic potash) dr., lb.	.06¼- .06½	.06¼- .06½	.07¼- .08
Muriate, 80% bgs., ton.	22.00 -......	22.00 -......	37.15 -......
Nitrate, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb.	.18 - .19	.18 - .19	.18 - .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	.90 - .95
Salt cake, bulk, ton.	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -......	1.23 -......	1.23 -......
Dense, bags, cwt.	1.25 -......	1.25 -......	1.25 -......
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb.	.04¾- .05	.04¾- .05	.04¾- .05
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05¼- .06⅛	.05¼- .06⅛	.05¼- .06⅛
Bisulphate, bulk, ton.	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03 - .04	.03 - .04	.03½- .04
Chlorate, kegs, lb.	.06¼- .06½	.06¼- .06½	.06¼- .06½
Chloride, tech., ton.	12.00 -14.75	12.00 -14.75	12.00 -14.75
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07 - .08
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	3.25 - 3.40	3.25 - 3.40	3.25 - 3.40
Nitrate, bags, cwt.	1.24 -......	1.24 -......	1.35 -......
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.022- .024	.022- 0.24	.02 - 0.23
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .02
Silicate (40° dr.) wks. cwt.	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb.	.02¼- .02½	.02¼ .02½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -......	18.00 -......	18.00 -......
Chloride, dr., lb.	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb.	.07 - .07½	.07 - .07½	.06½- .07
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.55 - 3.00
Tin Oxide, bbl. lb.	.56 -......	.56 -......	.55 -......
Crystals, bbl., lb.	.38 -......	.38 -......	.37½-......
Zinc chloride, gran., bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Carbonate, bbl., lb.	.09½- .11	.09½- .11	.09½- .11
Cyanide, dr., lb.	.38 - .42	.38 - .42	.38 - .42
Dust, bbl., lb.	.057- .07	.057- .07	.07 - .07½
Zinc oxide, lead free, bag, lb.	.05½-......	.06½-......	.05½-......
5% lead sulphate, bags, lb.	.05½-......	.06½-......	.05½-......
Sulphate, bbl., cwt.	2.75 - 3.00	2.75 - 3.00	3.00 - 3.25

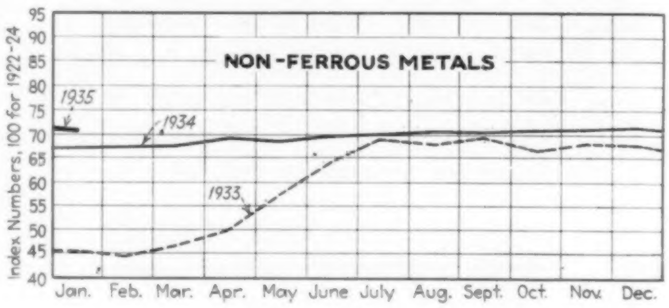
Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09¾-$0.10	$0.09¾-$0.10	$0.09¾-$0.10
Chinawood oil, bbl., lb.	.09¾-......	.092-......	.07¾-......
Coconut oil, Ceylon, tanks, N. Y. lb.	.05¾-......	.04¾-......	.02¾-......
Corn oil crude, tanks, (f.o.b. mill), lb	.10½-......	.09¾-......	.04½-......
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.09¾-......	.09½-......	.04 -......
Linseed oil, raw car lots, bbl., lb.	.091-......	.089-......	.093-......
Palm, casks, lb.	.04¾-......	.03¾-......	.03¾-......
Palm Kernel, bbl., lb.	nom.	nom.	.04 -......
Peanut oil, crude, tanks (mill), lb.	.10½-......	.09¾-......	.04½-......
Rapeseed oil, refined, bbl., gal.	.47 - .48	.41 - .42	.42 - .43
Soya bean, tank, lb.	.08¾-......	.07¾-......	.06 -......
Sulphur (olive foots), bbl., lb.	.08 -......	.07¾-......	.06½-......
Cod, Newfoundland, bbl., gal.	.36 -......	.36 -......	.35 -
Menhaden, light pressed, bbl., lb.	.06 -......	.055-......	.051-......
Crude, tanks (f.o.b. factory), gal.	.28 -......	.25 -......	.15 -......
Grease, yellow, loose, lb.	.05½-......	.05½-......	.02¾-......
Oleo stearine, lb.	.10½-......	.09½-......	.05½-......
Red oil, distilled, d.p. bbl., lb.	.07½-......	.07½-......	.07 -......
Tallow, extra, loose, lb.	.06 -......	.05½-......	.03½-......









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 –$0.65	$0.60 –$0.65	$0.60 –$0.62
Refined, bbl., lb.	.80 – .85	.80 – .85	.80 – .85
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.14½– .15	.14½– .15	.14½– .15
Aniline salts, bbl., lb.	.24 – .25	.24 – .25	.24 – .52
Benzaldehyde, U.S.P., dr., lb.	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl., lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs, lb.	.48 – .52	.48 – .52	.48 – .52
Benzyl chloride, tech., dr., lb.	.30 – .35	.30 – .35	.30 – .35
Benzol, 90%, tanks, works, gal.	.15 – .16	.15 – .16	.20½– .21
Beta-naphthol, tech., drums, lb.	.22 – .24	.22 – .24	.22 – .24
Cresol, U. S. P., dr., lb.	.11 – .11½	.11 – .11½	.11– .11½
Cresylic acid, 97%, dr., wks., gal.	.42 – .43	.50 – .51	.50 – .51
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.29 – .30	.29 – .30	.29 – .30
Dinitrotoluen, bbl. lb.	.16 – .17	.16 – .17	.16 – .17
Dip oil 25% dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.38 – .40	.38 – .40	.38 – .40
H-acid, bbl., lb.	.65 – .70	.65 – .70	.65 – .70
Naphthalene, flake, bbl., lb.	.05½– .06½	.05½– .06½	.04¾– .05
Nitrobenzene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.51 – .55	.51 – .55	.51 – .55
Phenol, U.S.P., drums, lb.	.14½– .15	.14½– .15	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal.	1.10 – 1.15	1.10 – 1.15	.90 – .95
Resorcinal, tech., kegs, lb.	.65 – .70	.65 – .70	.65 – .70
Salicylic acid, tech., bbl., lb.	.40 – .42	.40 – .42	.40 – .42
Solvent naphtha, w.w., tanks, gal.	.26 –......	.26 –......	.26 –......
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.30 –......	.30 –......	.30 –......
Xylene, com., tanks, gal.	.26 –......	.26 –......	.26 –......

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.11 – .12	.09½– .10	.11½– .13
China clay, dom., f.o.b mine, ton	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb.	.35½– .37	.35½– .37	.35 – .36
Ultramine blue, bbl., lb.	.06 – .32	.06 – .32	.06 – .32
Chrome green, bbl., lb.	.26 – .27	.26 – .27	.27 – .30
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	3.65 – 3.75
Para toner, lb.	.80 – .85	.80 – .85	.75 – .80
Vermilion, English, bbl., lb.	1.56 – 1.58	1.56 – 1.58	1.35 – 1.40
Chrome yellow, C. P., bbl., lb.	.15 – .16	.15 – .15½	.15 – .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.09 – .10	.09 – .10	.06 – .08
Manila, bags, lb.	.09 – .10	.09 – .10	.16 – .17
Damar, Batavia, cases, lb.	.15½– .16	.15½– .16	.16 – .16½
Kauri No. 1 cases, lb.	.20 – .25	.20 – .25	.45 – .48
Kieselguhr (f.o.b. N.Y.), ton	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –......	50.00 –......	40.00 –......
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	5.95 –......	5.85 –......	6.175–......
Turpentine, gal.	.55¼–......	.56 –......	.60¾–......
Shellac, orange, fine, bags, lb.	.31 –......	.35 –......	.26 – .27
Bleached, bonedry, bags, lb.	.24 – .30	.24 – .30	.29 – .31
T. N. bags, lb.	.18 – .21	.19 – .23	.21 – .22
Soapstone (f.o.b. Vt.), bags, ton	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton	13.75 –....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

The American Rolling Mill Co., Middletown, Ohio, has appointed The Central Steel and Wire Co. a distributor of Armco stainless steels. The company operates warehouses in Chicago, Detroit, and Dayton. Brace-Mueller-Huntley, Inc., of Rochester, Syracuse, and Buffalo, N. Y.; also has recently been appointed a distributor of Armco stainless steels.

Gilby Wire Co., Newark, N. J. has changed its name to the Wilbur B. Driver Co.

Krebs Pigment and Color Corp. whose main office has been located in Newark, N. J., since 1931, announces that on April 1, it will transfer its general offices to 1007 Market St., Wilmington, Del.

Illinois Steel Co., Chicago, has made Griswold A. Price, manager of sales of the St. Louis district for the parent company and also for Carnegie Steel Co. and Tennessee Coal, Iron and Railroad Co.

Foote Bros. Gear and Machine Co., Chicago, has appointed C. A. Hayward sales and engineering representative in the Detroit territory.

Sarco Co., Inc., New York, has opened an office at 1025 Broad St., Newark, N. J. with Walter Andrews and H. W. Angelery in charge.

Combustion Engineering Co., Inc., New York, announces that Carl Stripe has joined its sales organization and is in charge of industrial stoker sales.

Alsop Engineering Corp., New York, has named W. H. Lilly its Ohio representative with headquarters at 1903 Berkley Ave., Cincinnati.

Struthers-Wells Co., Pittsburgh, has moved its Chicago office to 122 So. Michigan Ave.

Northern Equipment Co., Erie, Pa., has appointed W. J. McDonough as sales manager. Thomas A. Read has rejoined the engineering department of the company.

O. Hommel Co., Pittsburgh, has added Frank L. Campbell to its organization in the capacity of general sales manager.

Electro Metallurgical Sales Corp., New York, has appointed Carl G. de Laval sales representative in the Pittsburgh territory.

The Pittsburgh Equitable Meter Co., Pittsburgh, announces that E. W. Bixby has joined that organization in a sales capacity and is connected with the newly opened office in Memphis, Tenn.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1935	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England	$58,000	....	$86,000	$75,000
Middle Atlantic	136,000	$28,000	529,000	80,000
South	684,000	228,000	949,000	384,000
Middle West	165,000	781,000	635,000	681,000
West of Mississippi	....	586,000	28,000	656,000
Far West	28,000	3,000,000	356,000	28,000
Canada	506,000	....	2,092,000	30,000
Total	$1,577,000	$4,623,000	$4,675,000	$1,934,000

PROPOSED WORK BIDS ASKED

Calcium Chloride Plant—Sidi Kenya Gas Co., Bombay, India, has purchased an acreage at Courtright, Ont., Can., and plans to construct a plant for the development of calcium chloride. T. F. Dickinson is local manager.

Chemical Plant—American Cynamid & Chemical Co., Bridgeville, Pa., is receiving bids for a 4 bay addition to Chemical Building No. 6, 1 story, 80x93 ft.

Cotton Seed Oil Plant—Mansura Cotton Oil Mill, Mansura, La., plans to rebuild its plant recently destroyed by fire with a loss of $35,000. Estimated cost including equipment $28,000. Maturity indefinite.

Distillery—Schenley Distillers Corp., Lawrenceburg, Ind., is having plans prepared for a distilling plant. Estimated cost $55,000.

Distillery—Virginia Brandy Co., Central National Bank Bldg., Richmond, Va., is having plans prepared by P. L. Hanks, Engr., Greensboro, N. C., for a distillery at North Garden, Va. Estimated cost $100,000.

Factory—Dominion Oil Cloth & Linoleum Co. Ltd., Parthenais St., Montreal, Que., Can., contemplates the construction of an addition to its factory. Estimated cost $100,000.

Factory—General Aniline Works, Inc., Riverside Ave., Rensselaer, N. Y., will soon take bids for the construction of superstructure for 5 story addition to factory. Contract for foundation has been awarded to Caisson Contracting Corp., 90 West St., New York, N. Y. Total estimated cost $80,000.

Fur Processing Plant—American Fur Co., 155 West South Temple St., Salt Lake City, Utah, plans to construct a fur processing plant.

Laboratories—Board of Education, 911 Locust St., St. Louis, Mo., will soon take bids for the construction of a high school to include seven laboratories. Estimated total cost $805,000.

Paint Factory—Tredennick Paint Manufacturing Co., Edward Tredennick, Pres., 301 South Colony St., Meriden, Conn., contemplates the construction of a plant to replace the one destroyed by fire. Estimated cost $30,000.

Pulp Plant—F. L. Buckley and Associates, Prince Rupert, B. C., Can., are preparing plans for a pulp plant. Estimated cost $250,000.

Paper Plant—Castanea Paper Co., Johnsonburg (Elk Co.), Pa., plans the construction of an experimental plant to treat sulphite waste. Estimated cost exceeds $28,000.

Paper Mill—International Hydro Electric Co., 220 East 42nd St., New York, N. Y., plans to repair Mill "B" at Franklin, N. H., to be leased by the International Paper Co., 220 East 42nd St., New York. Estimated cost including equipment $28,000. Maturity indefinite.

Perfume Factory—Givaudan-Delawanna, Inc., Eric C. Kunz, Vice Pres. and Treas., 80 Fifth Ave., New York, N. Y., is having plans prepared for a perfume factory near Belle, W. Va. Maturity in April or later.

Pottery Plant—Mountford Pottery Supply Co., East Liverpool, O., plans to construct a plant here. Estimated cost $35,000.

Processing Plant—Batson & Hatten Lumber Co., Lyman, Miss., plans to construct a plant for processing wood turpentine, wood rosin and by-products from stumps on cut overlands.

Plant—Galena Shale, Tile & Brick Co., Galena, O., plans to rebuild its plant recently destroyed by fire. Estimated cost $35,000.

Refinery—Consumers Refinery Co-Operative Association, Regina, Sask., plans the construction of a refinery. H. L. Fowler, Wilcox, Sask., Secy.

Refinery—Corporation c/o Del Fortney, Bay City, Mich., plans the construction of a refinery and cracking plant. Estimated cost $40,000.

Rayon Dyeing Plant—Textile Dyeing & Printing Corp. of America, Inc., Conrad Hirzel, Secy., Fair Lawn, N. J., has acquired the plant at Third and Hull Sts., South Richmond, Va., formerly occupied by the Simmons Mattress Co. and will alter same for its own use. The company will do light dyeing of artificial silk. Estimated cost $500,000.

Soap Factory—Procter & Gamble Co., Ivorydale, O., has acquired the plant formerly occupied by J. Barcelon & Cie., Montreal, Que., Can., and will alter same for its own use. Estimated cost including equipment $28,000.

Soap Factory—Royal Crown Soaps, King and Henry Sts., Winnipeg, Man., Can., is having plans prepared by H. H. Moody, c/o Company, for a 3 story, 72x130 ft. addition to its factory. Estimated cost $100,000.

CONTRACTS AWARDED

Copper Refinery—Consolidated Copper Mines Corp., Kimberly, Nev., and 120 Bway., New York, N. Y., plans to construct a copper refinery and mining and mill structures at Kimberly. Work will be done by separate contracts. RFC has granted loan for project. Estimated cost $3,000,000.

Cosmetic Factory—Plough, Inc., 34 34th St., Brooklyn, N. Y., will construct plant on East Parkway, Memphis, Tenn. Work will be done by separate contracts. A. L. Nelson, 31 St. James St., Boston, Mass., Engr.

Distillery—J. E. Pepper Distilling Co., Lawrenceburg, Ind., awarded contract for distillery to A. Lubrecht, Covington, Ky. Estimated cost $73,000.

Distillery—Old Quaker Distilling Co., Lawrenceburg, Ind., awarded contract 10 story, 150x158 ft. plant and warehouse to Frank Messer & Sons, 2515 Burnet Ave., Cincinnati, O. Estimated cost $300,000.

Distillery—G. T. Stagg Co., Lawrenceburg, Ind., awarded contract for distillery and warehouse, to Frank Messer & Sons, 2515 Burnet St., Cincinnati, O. Estimated cost $100,000.

Factory—Kingsbury & Co., J. W. Phillips, Supt., Peru, Ind., awarded contract for chemical fertilizer factory on Kelly St., to Clifton & Son, Peru. Estimated cost $29,000.

Glass Factory—Pittsburgh Plate Glass Co., Henryetta, Okla., awarded contract for addition to factory here to Manhattan Construction Co., Muskogee, Okla. Estimated cost $500,000.

Medicine Factory—Goodrich-Gamble Co., 1837 University Ave., St. Paul, Minn., manufacturer of patent medicines, plans to alter and enlarge its plant. Separate contracts have been awarded for the work. Estimated cost with equipment $30,000.

Oil Refinery—Bay Refining Co., c/o W. J. Sovereign, Bay City, Mich., plans to construct a refinery. Work will be done by separate contracts. Estimated cost $50,000.

Refinery—Naph-Sol Refining Co., Muskegon, Mich., will construct a Dubbs cracking unit at its crude oil refinery here. Work will be done by separate contracts under supervision of Universal Oil Products Co., Engr., 310 South Michigan Ave., Chicago, Ill. Estimated cost $200,000.

Refinery—Wilcox Oil & Gas Co., Bristow, Okla., awarded contract for stabilizer, vapor recovery and refinery alterations, to Burrell-Mase Engineering Co., Law & Finance Bldg., Pittsburgh, Pa. Estimated cost $28,000.

Rayon Mill—Burlington Mills, Greensboro, N. C., c/o S. R. Sell, Johnson City, Tenn., are awarding separate contracts for altering and installing new machinery in the mills formerly occupied by the Gloria Textile Mills, Johnson City, Tenn. The lessees will do rayon weaving. Estimated cost $200,000.

Storage Building—Thomas Ward Distilling Co., Cedarhurst, Md., awarded contract storage building to J. Walter Tovell, Eutaw and Monument Sts., Baltimore, Md. Estimated cost $28,000 or more.

Tannery—S. B. Foot Tanning Co., Red Wing, Minn., plans to construct a 3 story, 60x100 ft. tannery. Work will be done by separate contracts.

Wax Paper Factory—Cleveland Wax Paper Co., 13831 Triskett Rd., Cleveland, O., awarded contract for 1 story factory to Sam W. Emerson Co., 1836 Euclid Ave., Cleveland. Estimated cost $28,500.

Fertilizer Industry Entered Year With Favorable Prospects

ALTHOUGH some control of acreage to be planted this year might be construed as unfavorable for an expansion in the use of fertilizer, the experience of last year proves that curtailment of acreage—even of cotton acreage—does not necessarily mean reduction in fertilizer consumption. In fact the progress made in the fertilizer industry last year offers the real reason why the present year is regarded as favorable for a continuation of the rising line as regards sales volume and profits.

The accompanying chart prepared for the *Blue Eagle* presents a realistic picture of the status of the fertilizer industry last year. As interpreted by the Research and Planning Division of NRA the chart clearly shows a broad downward sweep from 1929 with a turning point sometime in 1932, followed by a substantial recovery. The first 10 months of 1934 compared with 1932 show that employment has increased about 51 per cent; pay rolls about 30 per cent; and consumption about 34 per cent. Activity in the industry, however, is still below 1929 levels—employment about 20 per cent; "real purchasing power" of pay rolls about 30 per cent, and consumption about 37 per cent less than the base year, 1929.

A more detailed and comprehensive perusal of the chart brings forth numerous significant relationships. In the upper section are shown three curves on hours and wages obtained through the courtesy of the Bureau of Labor Statistics. Except for seasonal peaks in the early spring, the curve representing the average number of hours worked per week moved uniformly on a level between 40 and 45 from January 1932 until mid-1933. For the remainder of 1933 it dropped sharply from 44.3 to 32.3 hours, and since then has been fluctuating about a new level between 32 and 35 hours per week. The curve showing average hourly wages during the period for which data are available, has varied from a low of about 20 cents in April 1933 to a high of about 41 cents in July of this year, a rate not only higher than that in the same month of last year but 18 per cent higher than the rate in July 1932—the peak month of that year. The recent decline to 37 cents in September, 1934 is due to seasonal factors; the hourly wage curve tending to decline after periods of peak employment in the fall and in the spring.

The indexes of employment and pay rolls taken from the publications of the Bureau of Labor Statistics and adjusted to 1933 Census totals by NRA, are shown in the central portion of the chart. In spite of the large seasonal movements, the upward swings since 1932, particularly in employment, are apparent. Pay rolls thus far in 1934 compared with the corresponding period of 1933 averaged about 40 per cent larger, the number employed about 32 per cent larger, and consumption in the Southern States about 14 per cent greater.

The index of consumption of fertilizers in 12 Southern States (representing 65 to 70 per cent of domestic consumption) is compiled by the National Fertilizer Association from reports of tax tag sales in those States. Seasonal fluctuations are so wide that consumption in the peak month of a year is frequently over 100 times as great as in the low month. Such fluctuations attended by more moderate seasonal movements in employment are probably unavoidable in view of the advantages of applying fertilizer during certain phases of the crop cycle. The possibility of deterioration of product requires that manufacturing operations, in large measure, take place shortly before consumption. Consumption in 1934 was at a rate 34 per cent above 1932, and about 14 per cent above 1933, although still about 37 per cent below 1929. This improvement during 1933 and 1934 may be attributed in part to the acreage curtailment program of the AAA which tends to develop more intensive farming methods. A further factor is the increase in farm incomes, the sales of fertilizers tending to vary directly with the price of such farm products as cotton and tobacco.

Recent Trends in the Fertilizer Industry